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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-238694

(43)Date of publication of application : 04.09.2001

(51)Int.Cl.

C12Q 1/02

(21)Application number : 2000-052470

(71)Applicant : NATL INST OF ADVANCED
INDUSTRIAL SCIENCE &
TECHNOLOGY METI
DAICEL CHEM IND LTD

(22)Date of filing : 28.02.2000

(72)Inventor : IWAHASHI HITOSHI
FUJITA KATSUHIDE
KAMEO TOSHIMI
TAKAHASHI SACHIKO
MATSUYAMA AKIKAZU

(54) METHOD FOR MICROBIOLOGICALLY IDENTIFYING CHEMICAL SUBSTANCE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for microbiologically identifying a sample chemical substance, because information for judging the property of toxicity or the kind of chemical substances causing the toxicity is not entirely afforded, though the bioassay utilized at present mainly measures only growth inhibition of unicell and the presence of the toxicity due to the chemical substances can be evaluated.

SOLUTION: This method for microbiologically identifying chemical substances features comprising a microorganism growth process for growing previously decided several kinds of marker microorganisms in the presence of the sample chemical substance under various concentrations of the sample chemical substance, a measurement process for measuring the relationship between the concentration of the sample chemical substance and the concentration of the marker microorganisms on the microorganism growth process and a comparison process for comparing the relationship between the concentration of the marker microorganisms and the concentration of the sample chemical substance obtained by the measurement process with the data showing the relationship between the concentration of a marker microorganism previously put away into a data bank and the concentration of a marker chemical substance.

LEGAL STATUS

[Date of request for examination] 28.02.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3446042

[Date of registration] 04.07.2003

[Number of appeal against examiner's decision]

of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The microorganism growth process of changing the concentration of this sample chemical under existence of a sample chemical, and growing two or more sorts of index microorganisms defined beforehand, The measurement process which measures the relation of the sample chemical concentration and index microorganism concentration in this microorganism growth process, The microbiological identification approach of the chemical characterized by consisting of a collating process collated with the data in which the relation of the index microorganism concentration and index chemical concentration which are making the data bank contain beforehand the relation of the this index microorganism concentration and this sample chemical concentration which were obtained at this measurement process is shown.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the microorganism-identification approach of a chemical.

[0002]

[Description of the Prior Art] Current, data base Chemical of a chemical The chemical of about 17 million affairs is registered into abstract. Among those, what 10,000 or more kinds of synthetic chemistry matter is accumulating into an environment is presumed, and the number is increasing every year. In the synthetic chemistry matter, after changing a form in direct or an environment, the matter which has a bad influence on ecology or the body is also contained. Therefore, it is necessary to evaluate quickly the effect which it has on ecology or the body about each chemical. Moreover, identification and the attempt which is going to carry out a quantum are made with various advanced gaging systems in the chemical which exists in an environment under the situation of being the social problem which an environmental pollution problem instigates national anxiety. However, no matter advanced

technique [what] it may use, in the present condition, it is said that about 10% of chemical can be identified. Therefore, it is more practical to establish the index which can express the toxicity of the chemical which exists in an environment rather than it identifies the strange chemical itself which exists in an environment. From the need mentioned above, toxic index-ization which used the simple toxicity evaluation trial (bioassay) in current and many engines is going to be made. It is the approach of measuring "change of the living thing-response by the chemical" using an animals-and-plants cell or a microorganism not using the bion in a bioassay, and evaluating "toxicity." However, the bioassay by which current use is carried out has only mainly measured the growth inhibition of a single cell. Although the toxic existence by the chemical can be estimated by this approach, the information for judging that toxic property and what kind of toxic chemical it is the toxicity resulting from is not acquired at all. [0003]

[Problem(s) to be Solved by the Invention] This invention makes it the technical problem to offer the approach of identifying a sample chemical microbiologically.

[0004]

[Means for Solving the Problem] this invention persons came to complete this invention, as a result of repeating research wholeheartedly that said technical problem should be solved. Namely, the microorganism growth process of according to this invention changing the concentration of this sample chemical under existence of a sample chemical, and growing two or more sorts of index microorganisms defined beforehand, The measurement process which measures the relation of the sample chemical concentration and index microorganism concentration in this microorganism growth process, The relation of the this index microorganism concentration and this sample chemical concentration which were obtained at this measurement process The microbiological identification approach of the chemical characterized by consisting of a collating process collated with the data in which the relation of the index microorganism concentration and index chemical concentration which the data bank is made to contain beforehand is shown is offered.

[0005]

[Embodiment of the Invention] The data bank for identifying the sample chemical microbiologically is used for the approach of this invention. This data bank is made to contain the data in which the relation of the index chemical concentration and index microorganism concentration which were measured beforehand is shown. Much data (only henceforth a microorganism / chemical concentration data) in which the relation of the index chemical concentration and index microorganism concentration which this data bank is made to contain is shown come out as much as possible, a certain thing is desirable, and when its microorganism / chemical concentration data is obtained newly, it is desirable to make the data bank contain that data quickly. It is good to make a microorganism / chemical concentration data and to make the data bank contain this using two or more sorts of index chemical matter which was beforehand determined as two or more sorts of index microorganisms defined beforehand in the case of this invention.

[0006] What shows inhibition nature to a microorganism as an index chemical is used. What shows the growth inhibition nature to the Escherichia coli shown below as such a thing was chosen. In the parenthesis after the compound made into the following, the minimum inhibition concentration to Escherichia coli is shown.

[0007] No.1 Methylmercury chloride (0.91microM)

No.2 Nickel chloride (1111microM)

No.3 2-Aminoanthracene (370microM)

No.4 Tributyltin chloride (0.1microM)

No.5 Malathion (222microM)

No.6 Phenol(17mM)

No.7 Lindane (6666microM)

- No.8 Pentachlorophenol (74microM)
- No.9 Trp-P -2 (Acetate) (37microM)
- No.10 4-Nitroquinoline-N-oxide (567microM)
- No.11 Benzo(a) pyrene (111microM)
- No.12 Paraquat (333microM)
- No.13 Maneb (37microM)
- No.14 Cadmium chloride (333microM)
- No.15 Bis phenol-A (123microM)
- No.16 Di-2-ethylhexyl phthalate (92.6microM)
- No.17 2, 5-Dichlorophenol (13.7microM)
- No.18 2, 4-Dichlorophenoxy acetic acid (247microM)
- No.19 Formaldehyde (555microM)
- No.20 p-Nonylphenol (666microM)
- No.21 Sodium Arsenite (111microM)
- No.22 Thiuram (12.3microM)
- No.23 2, 4, 5-Trichlorophenol (13.7microM)
- No.24 potassium dichlomite (33microM)
- No.25 Triphenyltin chloride (3.3microM)

[0008] Although 25 sorts were shown in the above about the index chemical, in order to perform more exact microbiological identification of a chemical, it is clear that it is desirable to select many chemicals as much as possible. Therefore, as for an index chemical, it is natural that it is not what is limited to the above-mentioned thing.

[0009] Although it is desirable to choose many things from which the class differed as an index microorganism, it is as follows when the example of the index microorganism is shown.

(1) *Acetobacter pasteurianus* IFO 3188 -- this microorganism is a microorganism which shows susceptibility to chloromethylmercury (methylmercury chloride). That growth is prevented nearly completely under about M 1micro existence of chloromethylmercury, and this microorganism produces clear growth inhibition also by 0.3micro concentration which is about M. The susceptibility over other chemicals is shown in Table 1.

(2) *Acetobacter pasteurianus* IFO 3129 -- this microorganism is a microorganism which shows susceptibility to a nickel chloride. This microorganism remained in the bottom of about M 0.17micro existence of a nickel chloride that about 60% of growth is shown. The susceptibility over other chemicals is shown in Table 2.

(3) *Glyosomyces rutagersensis* IFO 14488 -- this microorganism is a microorganism which shows susceptibility to 2-amino anthracene. This microorganism shows susceptibility also in about [2-amino anthracene 4.6microM] concentration. The susceptibility over other chemicals is shown in Table 3.

(4) *Aureobacterium esteraromatium* IFO 3752 -- this microorganism is a microorganism which shows susceptibility to chlorination tributyltin. This microorganism shows susceptibility to 0.003micro about M low concentration to chlorination tributyltin. The susceptibility over other chemicals is shown in Table 4.

(5) *Comamonas Testosteroni* IAM 1048 -- this microorganism is a microorganism which shows susceptibility to a malathion (Malathion). This microorganism produced clear growth inhibition under about M 0.3micro existence of a malathion. The susceptibility over other chemicals is shown in Table 5.

(6) *Pseudomonas synxantha* IFO 3913 -- this microorganism is a microorganism which shows susceptibility to a phenol. This microorganism showed clear growth inhibition by about M phenol 23micro concentration. The susceptibility over other chemicals is shown in Table 6.

(7) *Staphylococcus aureus* IFO 3060 -- this microorganism is a microorganism which shows susceptibility to the lindane (Lindane). This microorganism showed growth inhibition also in about lindane 0.34microM. The susceptibility over other chemicals is shown in Table 7. In

seven kinds of microorganisms shown above, the susceptibility over a chemical shows strong susceptibility to a chemical which differed and is different, respectively.

[0010] Growth (culture) of an index microorganism was performed using L culture medium (1% of yeast extracts, poly peptone 0.5%). Growth was performed at 25 degrees C on 96 hole microplate, and the growth (microorganism concentration) was observed with the absorbance of 650nm. In this case, to the culture medium, the predetermined chemical was added by predetermined concentration. The susceptibility (a microorganism / chemical concentration data) of said index microorganism to said index chemical is shown in anaphase Table 1 - 7. In addition, in Tables 1-7 shown below, a numeric value with an absorbance of 650nm shown in the column of growth is equivalent to the numeric value of the concentration (muM) of the chemical shown in the upper column. For example, the absorbances 102 and 0.116 of the column of the growth in (1) *Acetobacter pasteurianus* IFO3188 of Table 1 are equivalent to the concentration (muM) 0.000 and 0.034 of Methylmercury chloride of the upper column.

[0011]

[Table 1] (1) *Acetobacter pasteurianus* The chemical susceptibility Methylmercury of IFO3188 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm0.102 0.116 0.108 0.085 0.024 0.021 0.0240.025 0.024 0.024 0.018Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444370. [333] 1111. 000 3333. 000 growth () [Absorbance] at 650nm0.109 0.113 0.112 0.1190.114 0.114 0.1140.117 0.100 0.012 0.0132-Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111. -- 000 3333.000 growth (Absorbance at 650nm) 0.101 0.109 0.116 0.110 0.107 0.106 0.0900.089 0.065-0.048 - 0.091 Tributyltin chloride Concentration (muM) 0.000 0.003 0.010 0.0300.091 0.2720.815 2.444 7.333 22.000 66.000 growth (Absorbance at 650nm) 0.104 0.049 0.048 0.049 0.046 0.040 0.0180.016 0.011 0.015 0.024Malathion Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.66774.000 222.000 666.000 growth () [Absorbance] at 650nm0.111 0.111 0.127 0.120 0.126 0.120 0.1230.120 0.108 0.081 - 0.003Phenol Concentration (muM) 0.000 0.847 2.540 7.620 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth () [Absorbance] at 650nm0.107 0.112 0.124 0.108 0.107 0.099 0.0800.075 0.038 0.027 0.018Lindane(s) Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667 2222.000 6666. 000 growth () [Absorbanceat] 650nm0.108 0.111 0.119 0.121 0.118 0.085 0.0700.094 0.100 0.094-0.063Pentachlorophenol concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm0.104 0.113 0.123 0.111 0.086 0.037 0.0180.018 0.018 0.0170.014 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm0.098 0.120 0.121 0.110 0.111 0.102 0.0740.061 0.039 0.015 0.0744-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.000 growth Concentration (muM) () [Absorbance] at 650nm0.121 0.114 0.121 0.112 0.120 0.109 0.1040.098 0.082 0.018 0.014Benzo(es)(a) pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.093 0.090 0.121 0.120 0.120 0.115 0.1110.095 0.081 0.060 0.051Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037111.111 333.333 1000.000 growth (Absorbance at 650) nm) 0.110 0.107 0.114 0.107 0.103 0.093 0.0750.059 0.024 0.017 0.015Maneb Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000 growth () [Absorbance] at 650nm0.111 0.116 0.127 0.123 0.125 0.120 0.1140.085 0.014 0.009 0.018Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.106 0.098 0.115 0.115 0.111 0.102 0.0900.055 0.020 0.017 0.016 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333. 000 growth ()

[Absorbance] at 650nm 0.090 0.095 0.121 0.125 0.119 0.112 0.095 0.063 0.021 0.020
0.070 Di(s)-2-ethylhexyl phthalate concentration (muM) 0.000 0.042 0.127 0.381 1.143
3.428 10.284 30.852 92.556 277.667 833.000 growth () [Absorbance] at 650nm 0.091 0.087
0.118 0.114 0.118 0.116 0.110 0.094 0.066 0.047 0.0522 and 5-Dichlorophenol
Concentration (muM) 0.000 0.169 0.508 -- 1.524 4.572 13.716 41.148 123.444 370.333
1111.000 3333.000 growth (Absorbance at 650nm) 0.098 0.090 0.121 0.122 0.126 0.127
0.106 0.070 0.021 0.017 0.0172 and 4-Dichlorophenoxy acetic acid Concentration (muM)
0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth
(Absorbance at 650nm) 0.099 0.098 0.118 0.126 0.119 0.121 0.115 0.107 0.081 0.018
0.021 Formaldehyde Concentration (muM) 0.000 0.085 0.254 0.762 2.285 6.856
20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.109 0.098
0.116 0.116 0.115 0.114 0.112 0.086 0.048 0.019 0.015 p-Nonylphenol Concentration (muM)
0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth ()
[Absorbance] at 650nm 0.108 0.086 0.126 0.126 0.112 0.020 0.014 0.011 0.012 0.024
0.099 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370
4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.111 0.113 0.121
0.122 0.125 0.121 0.123 0.112 0.047 0.026 0.009 Thiuram Concentration (muM) 0.000 0.017
0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at
650nm 0.112 0.107 0.113 0.106 0.105 0.080 0.050 0.027 0.018 0.013 0.0132, 4, and 5-
Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444
370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.118 0.113 0.122 0.109
0.065 0.019 0.018 0.018 0.016 0.020 0.027 Potassium dichromate Concentration (muM) 0.000
0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000 growth (Absorbance at
650nm) 0.115 0.107 0.114 0.113 0.111 0.110 0.116 0.115 0.112 0.104 0.079 Triphenyltin
chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041 0.122 0.367 1.100
3.300 growth (Absorbance at 650nm) -- 0.107 0.112 0.110 0.106 0.105 0.106 0.100 0.108
0.104 0.091 -- 0.083 [0012]

[Table 2] (2) *Acetobacter pasteurianus* The chemical susceptibility Methylmercury of
IFO3129 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667
74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.260 0.313 0.292 0.269 0.165
0.036 0.047 0.047 0.041 0.034 0.032 Nickel chloride Concentration (muM) 0.000 0.169 0.508
1.524 4.572 13.716 41.148 123.444 370. [333] 1111.000 3333.000 growth () [Absorbance]
at 650nm 0.556 0.345 0.265 0.264 0.261 0.265 0.584 0.272 0.480 0.114 0.0262-
Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716
41.148 123.444 370.333 1111. -- 000 3333.000 growth (Absorbance at 650nm) 0.272 0.296
0.284 0.269 0.267 0.264 0.237 0.198 0.166 0.031-0.040 Tributyltin chloride Concentration
(muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth ()
[Absorbance] at 650nm 0.278 0.047 0.047 0.047 0.046 0.046 0.039 0.025 0.013 0.016
0.030 Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222
24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.265 0.252 0.255 0.253 0.243
0.230 0.231 0.223 0.214 0.168 0.083 Phenol(s) Concentration (muM) 0.000 0.847 2.540 7.620
22.861 68.584 205.753 617.259 1851.778 5555.333 16666.000 growth () [Absorbance] at
650nm 0.323 0.300 0.323 0.305 0.289 0.283 0.267 0.224 0.178 0.071 0.032 Lindane(s)
Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667
2222.000 6666.000 growth () [Absorbance at] 650nm 0.234 0.234 0.235 0.235 0.221 0.168
0.137 0.164 0.158 0.132-0.114 Pentachlorophenol concentration (muM) 0.000 0.034 0.102
0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at
650nm 0.271 0.228 0.213 0.199 0.155 0.073 0.029 0.021 0.023 0.021 0.021 Trp-P -2 (Acetate)
Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000
333.000 growth () [Absorbance] at 650nm 0.648 0.580 0.288 0.285 0.274 0.140 0.070 0.036
0.023 0.023 0.068 4-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.070 0.210 0.630

1.889 5.667 17.000 growth Concentration (muM) () [Absorbance] at 650nm 0.296 0.299
0.298 0.303 0.303 0.289 0.281 0.240 0.154 0.021 0.024 Benzo(es)(a) pyrene Concentration
(muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth
(Absorbance at 650nm) 0.077 0.079 0.078 0.079 0.076 0.074 0.071 0.054 0.047 0.047
0.048 Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346
37.037 111.111 1000.333.333 000 growth (Absorbance at 650nm) -- 0.349 0.311 0.314 0.276
0.236 0.193 0.156 0.123 0.049 0.032 0.024 Maneb(s) Concentration (muM) 0.000 0.017 0.051
0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm)
0.341 0.323 0.371 0.332 0.671 0.601 0.597 0.250 0.642 0.059 0.027 Cadmium chloride
Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000
333.000 growth () [Absorbance] at 650nm 0.252 0.247 0.245 0.227 0.210 0.192 0.160 0.120
0.021 0.017 0.024 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 -- 4.572
13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.246
0.257 0.242 0.250 0.242 0.225 0.201 0.090 0.030 0.024 0.178 Di-2-ethylhexyl phthalate
Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667
833.000 growth () [Absorbance] at 650nm 0.245 0.235 0.235 0.234 0.238 0.223 0.213 0.188
0.159 0.119 0.055 2 and 5-Dichlorophenol Concentration (muM) 0.000 0.169 0.508 -- 1.524
4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm)
0.252 0.264 0.260 0.262 0.235 0.238 0.230 0.193 0.036 0.029 0.024 2 and 4-Dichlorophenoxy
acetic acid Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889
740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.248 0.262 0.257 0.265 0.254
0.246 0.218 0.191 0.135 0.032 0.045 Formaldehyde Concentration (muM) 0.000 0.085 0.254
0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at
650nm) 0.252 0.266 0.248 0.247 0.262 0.233 0.227 0.174 0.035 0.034 0.033 p-Nonylphenol
Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000
666.000 growth () [Absorbance] at 650nm 0.280 0.271 0.275 0.269 0.249 0.185 0.012 0.010
0.010 0.014 0.042 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457
1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.281 0.265
0.234 0.165 0.279 0.282 0.265 0.259 0.166 0.036 0.013 Thiuram Concentration (muM) 0.000
0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth ()
[Absorbance] at 650nm 0.286 0.294 0.331 0.383 0.279 0.361 0.270 0.150 0.041 0.035 0.
0.252, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572
13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.285
0.270 0.265 0.201 0.110 0.027 0.026 0.023 0.022 0.035 0.046 Potassium dichromate
Concentration (muM) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000
growth (Absorbance at 650nm) 0.281 0.267 0.546 0.276 0.275 0.736 0.271 0.264 0.259 0.473
0.218 Triphenyltin chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041
0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.323 0.454 0.311 0.303 0.476
0.288 0.287 0.290 0.275 0.273 -- 0.240 [0013]
[Table 3] (3) *Glyosomyces rutgersensis* Chemical susceptibility Methylmercury chloride of
IFO14488 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000
222.000 666.000 growth () [Absorbance] at 650nm 0.066 0.065 0.069 0.068 0.047 0.042
0.038 0.032 0.026 0.021 0.018 Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524
4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at
650nm 0.041 0.038 0.039 0.042 0.042 0.044 0.042 0.040 0.025 0.025 0.024 2-
Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716
41.148 123.444 370.333 1111. -- 000 3333.000 growth (Absorbance at 650nm) 0.076 0.070
0.076 0.069 0.061 0.058 0.047 0.029 0.003 - 0.015 - 0.157 Tributyltin chloride Concentration
(muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth
(Absorbance at 650nm) 0.058 0.053 0.052 0.051 0.050 0.043 0.037 0.029 0.025 0.026
0.036 Malathion Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222

24.66774.000 222.000 666.000 growth () [Absorbance] at 650nm0.059 0.052 0.053 0.052
 0.054 0.053 0.0540.051 0.048 0.045 0.006Phenol(s) Concentration (muM) 0.000 0.847 2.540
 7.620 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth ()
 [Absorbance] at 650nm0.044 0.059 0.059 0.061 0.059 0.0540.0500.047 0.038 0.032
 0.025Lindane Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296
 246.889740.667 2222. 0006666.000 growth (Absorbance at650nm) 0.049 0.046 0.046 0.050
 0.049 0.048 0.0490.066 0.073 0.090-0.082Pentachlorophenol Concentration (muM) 0.000
 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth ()
 [Absorbance] at 650nm0.052 0.049 0.049 0.046 0.044 0.038 0.0290.027 0.028 0.028 0.030
 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.1520.457 1.370 4.11112.333
 37.000 111.000 333.000 growth () [Absorbance] at 650nm0.053 0.053 0.053 0.050 0.049
 0.047 0.0420.027 0.027 0.029 0.1334-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008
 0.0230.0700.210 0.630 1.8895.667 17.000 growth Concentration (muM) () [Absorbance] at
 650nm0.066 0.061 0.059 0.056 0.055 0.054 0.0480.047 0.043 0.036 0.030Benzo(es)(a)
 pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000
 111.000 333.000 growth () [Absorbance] at 650nm0.055 0.053 0.058 0.058 0.054 0.049
 0.0450.042 0.035 0.0260.019Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.053
 0.051 0.054 0.055 0.054 0.054 0.0510.049 0.052 0.046 0.041Maneb Concentration (muM)
 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000 growth
 (Absorbance at 650nm) -- 0.057 0.050 0.050 0.051 0.050 0.047 0.0440.042 0.032 0.025 0.030
 Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333
 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.045 0.043 0.042 0.037 0.033 0.033
 0.0330.031 0.029 0.029 0.027 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148123.444 370.333 1111. 000 3333. 000 growth () [Absorbance] at
 650nm0.060 0.058 0.062 0.064 0.059 0.055 0.0520.042 0.030 0.026 0.058Di(s)-2-ethylhexyl
 phthalate Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.42810.284 30.852 92.556
 277.667833.000 growth () [Absorbance] at 650nm0.052 0.052 0.053 0.051 0.053 0.051
 0.0500.039 0.036 0.022 0. 0202 and 5-Dichlorophenol Concentration (muM) 0.000 0.169
 0.508 -- 1.524 4.572 13.71641.148 123.444 370.333 1111.000 3333.000 growth (Absorbance
 at 650nm) 0.062 0.059 0.061 0.060 0.059 0.056 0.0540.044 0.030 0.024 0.0202 and 4-
 Dichlorophenoxy acetic acid Concentration (muM) 0.000 0.339 1.016 3.048 9.14427.432
 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.062 0.058
 0.063 0.061 0.057 0.055 0.0520.050 0.033 0.022 0.026Formaldehyde Concentration (muM)
 0.000 0.085 0.254 0.762 2.285 6.856 20.56861.704 185.111 555.333 -- 1666.000 growth
 (Absorbance at 650nm) 0.054 0.050 0.054 0.054 0.053 0.052 0.0510.050 0.048 0.036 0.021
 p-Nonylphenol Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667
 74.000 222.000 666.000 growth () [Absorbance] at 650nm0.056 0.054 0.052 0.052
 0.0480.045 0.0310.021 0.019 0.023 0.069Sodium Arsenite Concentration (muM) 0.000 0.017
 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [Absorbance] at
 650nm0.049 0.047 0.049 0.047 0.047 0.045 0.0440.040 0.040 0.0410.035Thiuram
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.33337.000 111.000
 333.000 growth () [Absorbance] at 650nm0.053 0.048 0.049 0.047 0.044 0.042 0.0340.028
 0.023 0.022 0. 0252, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524
 4.572 13.71641.148 123.444 370.333 1111.000 3333. 000 growth () [Absorbance] at
 650nm0.056 0.053 0.053 0.050 0.039 0.033 0.0310.0290.031 0.030 0.046 Potassium
 dichlomite Concentration (muM) 0.000 0.002 0.005 0.0150.045 0.1360.407 1.222 3.667
 11.000 33.000 growth (Absorbance at 650nm) 0.041 0.0360.041 0.043 0.043 0.043
 0.0440.042 0.040 0.037 0.037Triphenyltin chloride Concentration (muM) 0.000 0.0000.001
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300 growth (Absorbance at650nm) -- 0.044
 0.045 0.049 0.049 0.049 0.052 0.0500.044 0.034 0.026 -- 0.020 [0014]

[Table 4] (4) Chemical susceptibility Methylmercury chloride of *Aureobacterium* esteraromatum IFO 3752 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.091 0.107 0.110 0.093 0.043 0.023 0.022 0.023 0.022 0.021 0.018 Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.098 0.106 0.116 0.112 0.116 0.111 0.112 0.114 0.110 0.084 0.016 2-Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.095 0.093 0.113 0.104 0.099 0.099 0.090 0.091 0.069 0.008-0.108 Tributyltin chloride Concentration (muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth () [Absorbance] at 650nm 0.105 0.037 0.044 0.044 0.042 0.038 0.030 0.018 0.014 0.023 0.032 Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.101 0.098 0.122 0.120 0.119 0.113 0.105 0.100 0.088 0.068 - 0.001 Phenol Concentration (muM) 0.000 0.847 2.540 7.620 22.861 68.584 205.753 617.259 1851.778 5555.333 16666.000 growth () [Absorbance] at 650nm 0.100 0.099 0.121 0.114 0.107 0.105 0.101 0.098 0.085 0.045 0.023 Lindane(s) Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 2222.000 6666.000 growth () [Absorbance] at 650nm 0.103 0.110 0.131 0.132 0.126 0.099 0.077 0.093 0.103 0.111 - 0.059 Pentachlorophenol concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.095 0.098 0.116 0.115 0.093 0.054 0.022 0.021 0.019 0.017 0.021 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.089 0.098 0.107 0.107 0.103 0.089 0.056 0.039 0.030 0.023 0.056 4-Nitroquinoline-N-oxide Concentration (muM) 0.000 0.001 0.003 0.008 0.023 0.070 0.210 0.630 1.889 5.667 17.000 growth () [Absorbance at] 650nm 0.106 0.111 0.121 0.118 0.118 0.118 0.101 0.096 0.081 0.068 0.066 Benzo(a) pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.096 0.097 0.118 0.117 0.113 0.110 0.107 0.099 0.087 0.077 0.126 Paraquat(s) Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037 111.111 333.333 1000.000 growth (Absorbance at 650nm) 0.097 0.089 0.120 0.117 0.112 0.104 0.089 0.085 0.065 0.049 0.032 Maneb Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.107 0.102 0.121 0.120 0.122 0.119 0.116 0.105 0.074 0.024 0.036 Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.090 0.094 0.119 0.119 0.112 0.105 0.093 0.085 0.046 0.020 0.020 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 -- 1111.000 3333.000 growth (Absorbance at 650nm) 0.088 0.092 0.123 0.123 0.121 0.111 0.095 0.080 0.019 0.018 0.052 Di-2-ethylhexyl phthalate Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667 833.000 growth () [Absorbance] at 650nm 0.087 0.069 0.122 0.119 0.121 0.117 0.109 0.096 0.075 0.052 0.048 2 and 5-Dichlorophenol Concentration (muM) 0.000 0.169 0.508 -- 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.097 0.103 0.129 0.127 0.128 0.122 0.113 0.086 0.020 0.017 0.019 2 and 4-Dichlorophenoxy acetic acid Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.093 0.103 0.124 0.122 0.124 0.124 0.116 0.100 0.075 0.018 0.027 Formaldehyde Concentration (muM) 0.000 0.085 0.254 0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.097 0.107 0.122 0.123 0.119 0.121 0.120 0.112 0.084 0.044 0.015 p-Nonylphenol Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.102 0.090 0.076 0.111 0.108 0.095 0.015 0.016 0.013 0.022 0.101 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457

1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.098 0.094
 0.122 0.120 0.119 0.119 0.111 0.107 0.100 0.088 0.065 Thiuram Concentration (muM) 0.000
 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth ()
 [Absorbance] at 650nm 0.105 0.097 0.124 0.122 0.123 0.109 0.082 0.040 0.020 0.017 0.
 0.162, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572
 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.098
 0.095 0.115 0.110 0.081 0.021 0.020 0.020 0.020 0.023 0.033 Potassium dichromate
 Concentration (muM) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000
 growth (Absorbance at 650nm) 0.105 0.101 0.121 0.122 0.124 0.117 0.118 0.120 0.116 0.109
 0.088 Triphenyltin chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041
 0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.100 0.096 0.107 0.110 0.109
 0.103 0.100 0.085 0.056 0.029 -- 0.019 [0015]
 [Table 5] (5) Comamonas Testosteroni The chemical susceptibility Methylmercury of
 IAM1048 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667
 74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.420 0.419 0.417 0.381 0.080
 0.059 0.056 0.056 0.057 0.048 0.039 Nickel chloride Concentration (muM) 0.000 0.169 0.508
 1.524 4.572 13.716 41.148 123.444 370.333 [333] 1111.000 3333.000 growth () [Absorbance]
 at 650nm 0.316 0.302 0.314 0.313 0.303 0.302 0.293 0.285 0.279 0.178 - 0.0052-
 Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716
 41.148 123.444 370.333 1111. -- 000 3333 .000 growth (Absorbance at 650nm) 0.417 0.412
 0.435 0.420 0.425 0.413 0.390 0.335 0.248 0.118 - 0.084 Tributyltin chloride Concentration
 (muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth ()
 [Absorbance] at 650nm 0.401 0.406 0.401 0.394 0.373 0.268 0.155 0.074 0.056 0.051
 0.072 Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222
 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.341 0.341 0.346 0.319
 0.314 0.300 0.288 0.270 0.234 0.141 - 0.101 Phenol Concentration (muM) 0.000 0.847 2.540
 7.620 22.861 68.584 205.753 617.259 1851.778 5555.333 16666.000 growth ()
 [Absorbance] at 650nm 0.321 0.302 0.312 0.315 0.319 0.321 0.305 0.302 0.269 0.156
 0.000 Lindane(s) Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296
 246.889 740.667 2222.000 6666.000 growth () [Absorbance] at 650nm 0.323 0.312 0.316
 0.313 0.302 0.267 0.240 0.258 0.405 0.750 1.157 Pentachlorophenol(s) Concentration (muM)
 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth ()
 [Absorbance] at 650nm 0.393 0.404 0.401 0.400 0.379 0.337 0.282 0.158 0.039 0.035 0.037
 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333
 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.391 0.562 0.456 0.411 0.418 0.361
 0.267 0.089 0.046 0.035 0.089 4-Nitroquinoline-N-oxide Concentration (muM) 0.000 0.001
 0.003 0.008 0.023 0.070 0.210 0.630 1.889 5.667 17.000 growth () [Absorbance] at
 650nm 0.399 0.406 0.412 0.398 0.402 0.386 0.366 0.355 0.345 0.284 0.140 Benzo(es)(a)
 pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000
 111.000 333.000 growth () [Absorbance] at 650nm 0.416 0.425 0.445 0.443 0.432 0.430
 0.425 0.409 0.386 0.306 - 0.108 Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037 111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.327
 0.314 0.326 0.313 0.304 0.294 0.259 0.168 - 0.085 - 0.543 - 1.517 Maneb Concentration (muM)
 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth
 (Absorbance at 650nm) -- 0.316 0.304 0.314 0.311 0.304 0.303 0.284 0.257 0.165 0.041
 0.003 Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370
 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.307 0.294 0.302
 0.294 0.287 0.297 0.286 0.262 0.201 0.068 - 0.269 Bis-phenol-A Concentration (muM) 0.000
 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth
 (Absorbance at 650nm) 0.413 0.420 0.425 0.428 0.423 0.388 0.353 0.223 0.054 0.049
 0.157 Di-2-ethylhexyl phthalate Concentration (muM) 0.000 0.042 0.127 0.381 1.143

3.42810.284 30.852 92.556 277.667 833.000 growth () [Absorbance] at 650nm0.432 0.414
 0.440 0.437 0.438 0.426 0.4360.417 0.110 0.021 - 0.1432 and 5-Dichlorophenol
 Concentration (muM) 0.000 0.1690.508 1.524 4.572 13.71641.148 123.444 370.333
 1111.000 3333. 000 growth () [Absorbance] at 650nm0.436 0.442 0.447 0.449 0.454 0.430
 0.1340.083 0.054 0.049 0. 0402 and 4-Dichlorophenoxy acetic acid Concentration (muM)
 0.000 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.667 2222.000 6666.000 growth
 (Absorbance at 650nm) 0.427 0.430 0.438 0.443 0.446 0.4340.4210.390 0.099
 0.0440.052Formaldehyde(s) Concentration (muM) 0.000 0.085 0.254 0.762 2.285 6.856
 20.56861.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.437 0.428
 0.444 0.446 0.442 0.427 0.4330.429 0.430 0.382 0.077 p-Nonylphenol Concentration (muM)
 0.000 0.034 0.102 0.305 0.914 2.7418.22224.667 74.000 222.000 666.000 growth
 (Absorbance at 650nm) 0.403 0.387 0.412 0.408 0.388 0.364 0.2930.216 0.182 0.142
 0.022Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370
 4.11112.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm0.407 0.407 0.403
 0.436 0.416 0.399 0.3830.365 0.333 0.242 0.129Thiuram(s) Concentration (muM) 0.000
 0.0170.051 0.152 0.457 1.3704.111 12.33337.000 111.000 333.000 growth (Absorbanceat
 650nm) 0.404 0.401 0.426 0.416 0.391 0.362 0.2530.191 0.083 0.037 0. 0472, 4, and 5-
 Trichlorophenol Concentration (muM) 0.000 0.169 0.508 -- 1.524 4.572 13.71641.148
 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.411 0.398 0.397 0.390
 0.313 0.063 0.0500.052 0.049 0.041 0.077Potassium dichlomite Concentration (muM) 0.000
 0.002 0.005 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000 growth () [Absorbance] at
 650nm0.323 0.303 0.322 0.318 0.311 0.303 0.2960.296 0.289 0.273 0.226 Triphenyltin
 chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.0140.041 0.1220.367 1.100
 3.300 growth (Absorbance at 650nm) -- 0.321 0.315 0.328 0.327 0.317 0.304 0.2820.280
 0.237 -- 0.1970.118 [0016]
 [Table 6] (6) *Pseudomonas synxantha* Chemical susceptibility Methylmercury chloride of
 IFO 3913 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000
 222.000 666.000 growth () [Absorbance] at 650nm0.719 0.716 0.728 0.733 0.736 0.476
 0.0700.060 0.056 0.057 0.046Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148123.444 370.333 1111. 000 3333. 000 growth () [Absorbance] at
 650nm0.667 0.686 0.673 0.673 0.673 0.666 0.6620.666 0.659 0.542 0.0512-
 Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716
 41.148123.444 370.333 1111.000 -- 3333.000 growth (Absorbance at 650nm) 0.784 0.785
 0.804 0.794 0.805 0.803 0.7690.723 0.682 0.548 0.150Tributyltin chloride Concentration
 (muM) 0.000 0.003 0.010 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000 growth ()
 [Absorbance] at 650nm0.748 0.773 0.767 0.776 0.769 0.761 0.7610.729 0.351 0.077
 0.057Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222
 24.66774.000 222.000 666.000 growth (Absorbanceat 650nm) 0.717 0.714 0.708 0.696 0.695
 0.680 0.6880.706 0.778 0.751 0.180Phenol(s) Concentration (muM) 0.000 0.847 2.540 7.620
 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth () [Absorbance] at
 650nm0.624 0.649 0.646 0.615 0.594 0.541 0.4220.298 0.203 0.116 0.053Lindane(s)
 Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667
 2222.000 6666. 000 growth () [Absorbanceat] 650nm0.655 0.657 0.647 0.660 0.644 0.606
 0.5930.597 0.571 0.451-0.032Pentachlorophenol concentration (muM) 0.000 0.034 0.102
 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [Absorbance] at
 650nm0.770 0.775 0.774 0.763 0.756 0.726 0.7110.692 0.708 0.7310.158 Trp-P -2 (Acetate)
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000
 333.000 growth () [Absorbance] at 650nm0.701 0.712 0.726 0.723 0.723 0.714 0.7110.730
 0.700 0.382 0.1494-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630
 1.889 5.667 17.000 growth Concentration (muM) () [Absorbance] at 650nm0.746 0.754
 0.768 0.748 0.753 0.741 0.7180.725 0.747 0.845 0.630Benzo(es)(a) pyrene Concentration

(μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.782 0.802 0.814 0.819 0.803 0.806 0.793 0.775 0.773 0.774 0.558 Paraquat Concentration (μM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037 111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.680 0.691 0.679 0.669 0.659 0.638 0.555 0.440 0.308 0.221 0.154 Maneb Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 -- growth (Absorbance at 650nm) 0.695 0.720 0.712 0.697 0.676 0.668 0.669 0.692 0.760 0.808 0.261 Cadmium chloride Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.677 0.704 0.696 0.698 0.683 0.676 0.648 0.592 0.529 0.471 0.381 Bis-phenol-A Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) -- 0.787 0.805 0.812 0.817 0.821 0.807 0.821 0.836 0.573 0.686 0.455 Di-2-ethylhexyl phthalate Concentration (μM) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667 833.000 growth () [Absorbance] at 650nm 0.784 0.757 0.792 0.794 0.783 0.772 0.773 0.772 0.788 0.783 0.5822 and 5-Dichlorophenol Concentration (μM) 0.000 0.169 0.508 -- 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.788 0.805 0.810 0.818 0.822 0.824 0.830 0.852 0.767 0.075 0.0242 and 4-Dichlorophenoxy acetic acid Concentration (μM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.761 0.773 0.785 0.797 0.801 0.795 0.801 0.835 0.906 0.945 0.045 Formaldehyde Concentration (μM) 0.000 0.085 0.254 0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.765 0.752 0.776 0.784 0.785 0.779 0.789 0.789 0.784 0.765 0.740 p-Nonylphenol Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.758 0.762 0.775 0.763 0.737 0.708 0.726 0.621 0.484 0.420 0.289 Sodium Arsenite Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.776 0.773 0.786 0.778 0.762 0.735 0.715 0.680 0.663 0.615 0.520 Thiuram Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.769 0.773 0.774 0.771 0.773 0.756 0.737 0.703 0.652 0.624 0.3542, 4, and 5-Trichlorophenol Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.750 0.759 0.763 0.759 0.736 0.701 0.657 0.562 0.044 0.033 0.081 Potassium dichromate Concentration (μM) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000 growth (Absorbance at 650nm) 0.644 0.664 0.668 0.659 0.651 0.631 0.636 0.634 0.630 0.602 0.501 Triphenyltin chloride Concentration (μM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041 0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.624 0.631 0.621 0.636 0.635 0.622 0.621 0.641 0.672 0.738 -- 0.418 [0017]

[Table 7] (7) Staphylococcus aureus Chemical susceptibility Methylmercury chloride of IFO 3060 Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at 650nm 0.184 0.198 0.200 0.189 0.007 0.006 0.006 0.007 0.008 0.007 0.005 Nickel chloride Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.237 0.232 0.226 0.227 0.224 0.220 0.216 0.216 0.208 0.111 0.0072- Aminoanthracene Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 -- 3333.000 growth (Absorbance at 650nm) 0.174 0.181 0.176 0.173 0.170 0.168 0.167 0.155 0.124 0.121 0.033 Tributyltin chloride Concentration (μM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth () [Absorbance] at 650nm 0.154 0.177 0.185 0.183 0.160 0.109 0.085 0.045 0.020 0.010 0.029 Malathion(s) Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.235 0.226 0.223 0.219 0.216 0.211 0.215 0.222 0.231 0.226 0.063 Phenol(s) Concentration (μM) 0.000 0.847 2.540 7.620

22.861 68.584 205.753 617.259 1851.778 5555.333 16666.000 growth () [Absorbance] at
 650nm 0.256 0.192 0.199 0.198 0.197 0.193 0.193 0.190 0.180 0.159 0.043 Lindane(s)
 Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667
 2222.000 6666.000 growth () [Absorbance at] 650nm 0.177 0.095 0.085 0.080 0.075 0.071
 0.080 0.074 0.106 0.055-0.230 Pentachlorophenol concentration (muM) 0.000 0.034 0.102
 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [Absorbance] at
 650nm 0.146 0.148 0.142 0.129 0.107 0.090 0.073 0.041 0.007 0.002 0.004 Trp-P -2 (Acetate)
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000
 333.000 growth () [Absorbance] at 650nm 0.189 0.200 0.199 0.187 0.176 0.143 0.084 0.041
 0.017 0.012 0.085 4-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.070 0.210 0.630
 1.889 5.667 17.000 growth Concentration (muM) () [Absorbance] at 650nm 0.182 0.185
 0.185 0.183 0.181 0.177 0.185 0.188 0.191 0.170 0.104 Benzo(es)(a) pyrene Concentration
 (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth
 (Absorbance at 650nm) 0.162 0.164 0.156 0.158 0.138 0.114 0.094 0.076 0.068 0.062
 0.094 Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346
 37.037 111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.249 0.241 0.218 0.217
 0.217 0.211 0.196 0.177 0.174 0.175 0.161 Maneb Concentration (muM) 0.000 0.017
 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at
 650nm 0.232 0.230 0.225 0.226 0.223 0.215 0.216 0.212 0.187 0.134 0.013 Cadmium chloride
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 33
 3.000 growth () [Absorbance at] 650nm 0.237 0.233 0.221 0.215 0.203 0.164 0.159 0.123
 0.090 0.076 0.029 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716
 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.159 0.158
 0.156 0.156 0.158 0.163 0.162 0.109 0.003 0.003 0.085 Di-2-ethylhexyl phthalate
 Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667
 833.000 growth () [Absorbance] at 650nm 0.158 0.157 0.159 0.152 0.153 0.150 0.151 0.153
 0.143 0.080 0.069 2, 4-Dichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm)
 0.156 0.162 0.158 0.157 0.156 0.152 0.086 0.053 0.029 0.001 0.002 2, 4-Dichlorophenoxy
 acetic acid concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889
 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.158 0.159 0.155 0.159 0.159
 0.153 0.146 0.116 0.066 0.005 0.011 Formaldehyde Concentration (muM) 0.000 0.085 0.254
 0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at
 650nm) 0.160 0.159 0.163 0.164 0.162 0.161 0.159 0.161 0.160 0.156 0.147 p-Nonylphenol
 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000
 666.000 growth () [Absorbance] at 650nm 0.158 0.165 0.164 0.167 0.143 0.156 0.070 0.068
 0.052 0.055 0.160 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457
 1.370 4.111 12.333 37.000 111.000 333.000 growth () [Absorbance] at 650nm 0.148 0.148
 0.148 0.147 0.149 0.143 0.141 0.131 0.094 0.094 0.070 Thiuram Concentration (muM) 0.000
 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth ()
 [Absorbance] at 650nm 0.145 0.150 0.150 0.153 0.151 0.146 0.134 0.092 0.029 0.006 0.
 0042, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572
 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [Absorbance] at 650nm 0.152
 0.155 0.161 0.154 0.109 0.034 0.006 0.005 0.006 0.000 Potassium dichromate
 Concentration (muM) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000
 growth (Absorbance at 650nm) 0.241 0.227 0.225 0.224 0.220 0.216 0.219 0.222 0.218 0.207
 0.188 Triphenyltin chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041
 0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.256 0.274 0.260 0.257 0.255
 0.254 0.248 0.232 0.129 0.097 -- 0.024 [0018] It is desirable to choose many things from
 which the class which is easy to receive growth inhibition differed as an index microorganism.
 It is good to select the indispensable index microorganism to each chemical as such a

microorganism. In order to select this indispensable index microorganism, first, the least concentration which checks growth of that *Escherichia coli* is measured about each chemical, and the multiple selection of the microorganism which receives growth inhibition from this minimum inhibition concentration by low concentration is made (primary screening). Next, the microorganism chosen by this primary screening is grown under existence of the index chemical of different concentration, and the property of the growth inhibition by that chemical is observed. The microorganism which shows susceptibility most to that chemical in the microorganism chosen by primary screening is chosen from this result as an indispensable index microorganism. Of course, as an index microorganism, various kinds of microorganisms which are easy to receive growth inhibition from the *Escherichia coli* other than this indispensable index microorganism can be made into an index microorganism.

[0019] Index chemicals, such as Methylmercury chloride, Nickel chloride, 2-Aminoanthracene, Malathion, Phenol, and Lindane, have clearly remarkable inhibition of as opposed to an index microorganism except for Methylmercury chloride so that I may be understood from the result shown in said tables 1-7. However, about Methylmercury chloride and Tributyltin chloride, remarkable growth inhibition was accepted by two or more microorganisms besides the index microorganism. Although an almost comparable inhibition property is shown to all index microorganisms about Methylmercury chloride, since such a chemical is not accepted, it can be understood to be what shows the description of Methylmercury chloride by other 24 kinds. About Tributyltin chloride, since inhibition is shown only within three kinds of microorganisms, this can also be understood to be what the growth spectrum expresses the description of Tributyltin chloride to. The growth property or production spectrum (microorganism / chemical concentration data) of reflect [the description of a chemical] of an index microorganism to the above-mentioned chemical is clear from the above thing.

[0020] About Pentachlorophenol, Trp-P -2 (Acetate), 4-Nitroquinoline-N-oxide, Benzo(a) pyrene, Paraquat, Maneb, and Cadmium chloride, since the microorganism which shows susceptibility to these compounds exists, the growth spectrum is characteristic. For example, *Acetobacter pasteurianus* IF03129 showed susceptibility to Pentachlorophenol. Although this microorganism was originally selected as a microorganism which shows susceptibility to Nickel chloride, it can be understood that there is susceptibility also in Pentachlorophenol. However, since the susceptibility over other Pentachlorophenol(s) and Nickel chloride of a microorganism differs, it is shown that the growth spectrum is that from which both chemicals differ clearly. Although similarly the index microorganism which shows susceptibility exists also about Trp-P -2 (Acetate), 4-Nitroquinoline-N-oxide, Benzo(a) pyrene, Paraquat, Maneb, and Cadmium chloride, it is distinguishable from spectrums other than the microorganism concerned differing.

[0021] The microorganism which shows susceptibility notably did not exist about Bisphenol-A, Di-2-ethyl hexylphthalate, 2, 5-Dichlorophenol, 2, 4-Dichlorophenoxy acid, Formaldehyde, p-Nonylphenol, Sodium Arsenite, Thiuram, 2 and 4, 5-Trichlorophenol, Potassium dichromate, and Triphenyltin chloride. If 2, 5-Dichlorophenol and 2, 4-Dichlorophenoxy acetic acid, 2 and 4, and 5-Trichlorophenol are removed among these compounds, since the susceptibility of the microorganism to these compounds differs, the growth spectrum of a chemical has brought a characteristic result. About 2, 5-Dichlorophenol, 2, 4-Dichlorophenoxy acetic acid, 2 and 4, and 5-Trichlorophenol, the growth spectrum was similar. However, since these compounds are analogue, it is guessed that the toxicity is also similar and it can be considered to be natural that a growth spectrum is similar. On the contrary, in order that this invention method may express the toxicity of a chemical, it is possible that it is the example which shows the effective thing.

[0022] The approach of this invention includes the process which grows two or more index microorganisms in the bottom of existence of a sample chemical. The conditions for growth

in this case are the same conditions as the time of growing an index chemical under existence of the above mentioned index microorganism. Moreover, the approach of this invention includes the measurement process which measures the relation of the microorganism concentration and the nature concentration of a sample compound in said growth process. The approach of this invention includes the collating process which collates the microorganism / chemical concentration data obtained at said measurement process with the index microorganism / index chemical concentration data contained by said data bank. In this collating process, it is identified that that quality of a sample compound is identically [to a sample chemical] the same as that of the index chemical in that detected data microbiologically when the index microorganism / index chemical concentration data to approximate are detected, or the thing to approximate. The sample chemical which can be used for this invention does not need to be a high grade chemical, and can be the environmental water containing a chemical, polluted water polluted with the chemical. Each of each above mentioned processes can be performed automatically. Collating with the data contained by the data bank of the data obtained at the measurement process can be automatically performed using a computer.

[0023]

[Effect of the Invention] According to this invention, a sample chemical can be identified microbiologically. That is, the toxicity over the microorganism of the class and structure of the chemical, and its chemical can be known by the microbiological technique. Such an approach was not learned at all conventionally, but it was obtained for the first time by this invention, and the industrial meaning is great.

[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-238694

(43)Date of publication of application : 04.09.2001

(51)Int.Cl.

C12Q 1/02

(21)Application number : 2000-052470

(71)Applicant : NATL INST OF ADVANCED
INDUSTRIAL SCIENCE &
TECHNOLOGY METI
DAICEL CHEM IND LTD

(22)Date of filing : 28.02.2000

(72)Inventor : IWAHASHI HITOSHI
FUJITA KATSUHIDE
KAMEO TOSHIMI
TAKAHASHI SACHIKO
MATSUYAMA AKIKAZU

(54) METHOD FOR MICROBIOLOGICALLY IDENTIFYING CHEMICAL SUBSTANCE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for microbiologically identifying a sample chemical substance, because information for judging the property of toxicity or the kind of chemical substances causing the toxicity is not entirely afforded, though the bioassay utilized at present mainly measures only growth inhibition of unicell and the presence of the toxicity due to the chemical substances can be evaluated.

SOLUTION: This method for microbiologically identifying chemical substances features comprising a microorganism growth process for growing previously decided several kinds of marker microorganisms in the presence of the sample chemical substance under various concentrations of the sample chemical substance, a measurement process for measuring the relationship between the concentration of the sample chemical substance and the concentration of the marker microorganisms on the microorganism growth process and a comparison process for comparing the relationship between the concentration of the marker microorganisms and the concentration of the sample chemical substance obtained by the measurement process with the data showing the relationship between the concentration of a marker microorganism previously put away into a data bank and the concentration of a marker chemical substance.

LEGAL STATUS

[Date of request for examination] 28.02.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3446042

[Date of registration] 04.07.2003

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's

decision of rejection]

[Date of extinction of right]

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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2001-238694

(P2001-238694A)

(43) 公開日 平成13年9月4日 (2001.9.4)

(51) Int.Cl.⁷

識別記号

F I

サーチワード (参考)

C 1 2 Q 1/02

C 1 2 Q 1/02

4 B 0 6 3

審査請求 有 請求項の数 1 O L (全 12 頁)

(21) 出願番号 特願2000-52470(P2000-52470)

(22) 出願日 平成12年2月28日 (2000.2.28)

(71) 出願人 301000011

経済産業省産業技術総合研究所長

東京都千代田区霞が関1丁目3番1号

(74) 上記1名の復代理人 100074505

弁理士 池浦 敏明

(71) 出願人 000002901

ダイセル化学工業株式会社

大阪府堺市東区1番地

(74) 上記1名の代理人 100074505

弁理士 池浦 敏明

(72) 発明者 岩橋 均

茨城県つくば市東1丁目1番3 工業技術

院生命工学工業技術研究所内

最終頁に続く

(54) 【発明の名称】 化学物質の微生物学的同定方法

(57) 【要約】

【課題】 試料化学物質を、微生物学的に同定する方法を提供する。

【解決手段】 あらかじめ定めた複数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データベースにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法。

【特許請求の範囲】

【請求項1】 あらかじめ定めた複数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データバンクにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、化学物質の微生物的同定方法に関するものである。

【0002】

【従来の技術】現在、化学物質のデータベースChemical abstractには約1700万件の化学物質が登録されている。そのうち、1万種類以上の合成化学物質が環境中に蓄積しているものと推定され、その数は年々増えている。合成化学物質の中には、直接または環境中で形を変えた後に生態や人体に悪影響を与える物質も含まれている。そのため、それぞれの化学物質について、生態や人体に与える影響を迅速に評価する必要がある。また、環境汚染問題が国民の不安をあおるような社会問題となっている状況の下、種々の高度な測定システムで、環境中に存在する化学物質を同定・定量しようとする試みがなされている。しかしながら、どのような高度な技術を用いても、現状では約10%の化学物質を同定できないと言われている。従って、環境中に存在する未知の化学物質そのものを同定するよりも、環境中に存在する化学物質の毒性を表現できる指標を確立する方が実用的である。上述した必要性から、現在、多機関で簡易毒性評価試験（バイオアッセイ）を利用した毒性の指標化がなされようとしている。バイオアッセイでは生物個体を用いず動植物細胞や微生物を用いて「化学物質による生物学的応答の変化」を測定し、「毒性」を評価する方法である。ところが、現在利用されているバイオアッセイは主として単一細胞の生育阻害を測定しているだけである。この方法では、化学物質による毒性の有無は評価できるが、その毒性の性質やどのような化学物質に起因する毒性であるかを判断するための情報が全く得られない。

【0003】

【発明が解決しようとする課題】本発明は、試料化学物質を、微生物学的に同定する方法を提供することをその課題とする。

【0004】

【課題を解決するための手段】本発明者らは、前記課題を解決すべく鋭意研究を重ねた結果、本発明を完成するに至った。即ち、本発明によれば、あらかじめ定めた複

数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データバンクにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法が提供される。

【0005】

【発明の実施の形態】本発明の方法は、その試料化学物質を微生物学的に同定するためのデータバンクを用いる。このデータバンクには、あらかじめ測定した指標化学物質濃度と指標微生物濃度との関係を示すデータを収納させておく。このデータバンクに収納させる指標化学物質濃度と指標微生物濃度との関係を示すデータ（以下、単に微生物／化学物質濃度データとも言う）は、できるだけ多数であることが好ましく、その微生物／化学的濃度データが新しく得られたときには、迅速にそのデータをデータバンクに収納させるのが好ましい。本発明の場合、あらかじめ定めた複数種の指標微生物とあらかじめ定めた複数種の指標化学物質とを用いて、微生物／化学物質濃度データを作り、これをデータバンクに収納させておくのがよい。

【0006】指標化学物質としては、微生物に対して阻害性を示すものが用いられる。このようなものとしては、以下に示す大腸菌に対する生育阻害性を示すものを選んだ。下記にした化合物の後のカッコ内に、大腸菌に対するその最低阻害濃度を示す。

【0007】No. 1 Methylmercury chloride
(0.91 μ M)

No. 2 Nickel chloride (1111 μ M)

No. 3 2-Aminoanthracene (370 μ M)

No. 4 Tributyltin chloride (0.1 μ M)

No. 5 Malathion (222 μ M)

No. 6 Phenol (17 mM)

No. 7 Lindane (6666 μ M)

No. 8 Pentachlorophenol (74 μ M)

No. 9 Trp-P-2(Acetate) (37 μ M)

No. 10 4-Nitroquinoline-N-oxide (567 μ M)

No. 11 Benzo(a)pyrene (111 μ M)

No. 12 Paraquat (333 μ M)

No. 13 Maneb (37 μ M)

No. 14 Cadmium chloride (333 μ M)

No. 15 Bis phenol-A (123 μ M)

No. 16 Di-2-ethylhexyl phthalate (92.6 μ M)

No. 17 2,5-Dichlorophenol (13.7 μ M)

No. 18 2,4-Dichlorophenoxy acetic acid (247 μ M)

- No. 19 Formaldehyde (555 μ M)
 No. 20 p-Nonylphenol (666 μ M)
 No. 21 Sodium Arsenite (111 μ M)
 No. 22 Thiuram (12.3 μ M)
 No. 23 2,4,5-Trichlorophenol (13.7 μ M)
 No. 24 potassium dichromate (33 μ M)
 No. 25 Triphenyltin chloride (3.3 μ M)

【0008】指標化学物質に関しては、前記においては25種を示したが、化学物質のより正確な微生物学的同定を行うには、できるだけ多数の化学物質を選定するのが好ましいことは明らかである。従って、指標化学物質は上記のものに限定されるものでないことは当然である。

【0009】指標微生物としては、その種類が異なったものを多数選ぶのが好ましいが、その指標微生物の具体例を示すと以下の通りである。

(1) *Acetobacter pasteurianus* IF0 3188

この微生物は、塩化メチル水銀 (methylmercury chloride) に対して感受性を示す微生物である。この微生物は、1 μ M程度の塩化メチル水銀の存在下ではほぼ完全にその生育が阻止され、0.3 μ M程度の濃度でも明らかな増殖阻害を生じる。他の化学物質に対する感受性は表1に示す。

(2) *Acetobacter pasteurianus* IF0 3129

この微生物は、塩化ニッケルに感受性を示す微生物である。この微生物は0.17 μ M程度の塩化ニッケルの存在下では60%程度の生育を示すにとどまった。他の化学物質に対する感受性は表2に示す。

(3) *Glycomyces rutgersensis* IF0 14488

この微生物は、2-アミノアントラセンに感受性を示す微生物である。この微生物は、2-アミノアントラセン4.6 μ M程度の濃度においても感受性を示す。他の化学物質に対する感受性は表3に示す。

(4) *Aureobacterium esteraromatium* IF0 3752

この微生物は、塩化トリブチルスズに感受性を示す微生物である。この微生物は、塩化トリブチルスズに対しては0.003 μ M程度の低濃度まで感受性を示す。他の化学物質に対する感受性は表4に示す。

(5) *Comamonas Testosteroni* IAM 1048

この微生物は、馬拉チオン (Malathion) に感受性を示す微生物である。この微生物は、0.3 μ M程度の馬拉チオンの存在下で明らかな生育阻害を生じた。他の化学物質に対する感受性は表5に示す。

(6) *Pseudomonas synxantha* IF0 3913

この微生物は、フェノールに感受性を示す微生物である。この微生物は、フェノール濃度23 μ M程度で明らかな増殖阻害を示した。他の化学物質に対する感受性は表6に示す。

(7) *Staphylococcus aureus* IF0 3060

この微生物は、リンダン (Lindane) に感受性を示す微

生物である。この微生物は、リンダン0.34 μ M程度においても生育阻害を示した。他の化学物質に対する感受性は表7に示す。以上に示した7種類の微生物は、化学物質に対する感受性は異なり、それぞれ異なった化学物質に対して強い感受性を示す。

【0010】指標微生物の生育 (培養) は、L培地 (酵母エキス1%、ポリペプトン0.5%) を用いて行った。生育は、96穴マイクロプレート上で25℃で行ない、650 nmの吸光度でその生育 (微生物濃度) を観察した。この場合、培地には、所定化学物質を所定濃度で添加した。後記表1～表7に、前記指標化学物質に対する前記指標微生物の感受性 (微生物/化学物質濃度データ) を示す。なお、以下に示す表1～7において、生育の欄に示した650 nmの吸光度の数値は、その上欄に示した化学物質の濃度 (μ M) の数値に対応するものである。例えば、表1の(1) *Acetobacter pasteurianus* IF03188における生育の欄の吸光度1.02及び0.116は、その上欄のMethylmercury chlorideの濃度 (μ M) 0.000及び0.034に対応するものである。

【0011】

【表1】(1) *Acetobacter pasteurianus* IF03188の化学物質感受性

Methylmercury chloride 濃度 (μ M)	0.000	0.034	0.10	2	0.305	0.914	2.7418	222	24.667	74.000	222.000	66	6.000
生育 (Absorbance at 650nm)	0.102	0.116	0.108	0.085	0.024	0.021	0.024	0.025	0.024	0.024	0.018		
Nickel chloride 濃度 (μ M)	0.000	0.169	0.508	1.524	4.572	13.716	41.148	123.444	370.333	1111.000	3333.000		
生育 (Absorbance at 650nm)	0.109	0.113	0.112	0.119	0.114	0.114	0.114	0.117	0.100	0.012	0.013		
2-Aminoanthracene 濃度 (μ M)	0.000	0.169	0.508	1.5	24	4.572	13.716	41.148	123.444	370.333	1111.000	333	3.000
生育 (Absorbance at 650nm)	0.101	0.109	0.116	0.110	0.107	0.106	0.090	0.089	0.065	-0.048	-0.091		
Tributyltin chloride 濃度 (μ M)	0.000	0.003	0.010	0.030	0.091	0.272	0.815	2.444	7.333	22.000	66.000		
生育 (Absorbance at 650nm)	0.104	0.049	0.048	0.049	0.046	0.040	0.018	0.016	0.011	0.015	0.024	Malathion	
濃度 (μ M)	0.000	0.034	0.102	0.305	0.914	2.741	8.222	24.667	74.000	222.000	666.000		
生育 (Absorbance at 650nm)	0.111	0.111	0.127	0.120	0.126	0.120	0.123	0.120	0.108	0.081	-0.003		
Phenol 濃度 (μ M)	0.000	0.847	2.540	7.620	22.861	68.584	205.753	617.259	1851.778	5555.333	16666.000		
生育 (Absorbance at 650nm)	0.107	0.112	0.124	0.108	0.107	0.099	0.080	0.075	0.038	0.027	0.018		
Lindane 濃度 (μ M)	0.000	0.339	1.016	3.048	9.144	2							

7.432 82.296 246.889740.667 2222.000 6666.000生育	0.119 0.121 0.1150.107 0.081 0.018 0.021Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.285 6.856
(Absorbance at 650nm) 0.108 0.111 0.119 0.121 0.18 0.085 0.0700.094 0.100 0.094 -0.063	20.56861.704 185.111 555.333 1666.000
Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000	生育 (Absorbance at 650nm) 0.109 0.098 0.116 0.116 0.115 0.114 0.1120.086 0.048 0.019 0.015
生育 (Absorbance at 650nm) 0.104 0.113 0.123 0.111 0.086 0.037 0.0180.018 0.018 0.017 0.014	p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000
Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000	生育 (Absorbance at 650nm) 0.108 0.086 0.126 0.126 0.112 0.020 0.0140.011 0.012-0.024 0.099
生育 (Absorbance at 650nm) 0.098 0.120 0.121 0.110 0.111 0.102 0.0740.061 0.039 0.015 0.074	Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000
4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.000	生育 (Absorbance at 650nm) 0.111 0.113 0.121 0.122 0.125 0.121 0.1230.112 0.047 0.026 0.009Thiuram
生育 (Absorbance at 650nm) 0.121 0.114 0.121 0.112 0.120 0.109 0.1040.098 0.082 0.018 0.014	濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.33337.000 111.000 333.000
Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000	生育 (Absorbance at 650nm) 0.112 0.107 0.113 0.106 0.105 0.080 0.0500.027 0.018 0.013 0.013
生育 (Absorbance at 650nm) 0.093 0.090 0.121 0.120 0.120 0.115 0.1110.095 0.081 0.060 0.051	2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.524 4.572 13.71641.148 123.444 370.333 1111.000
Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037111.111 333.333 1000.000	3333.000
生育 (Absorbance at 650nm) 0.110 0.107 0.114 0.107 0.103 0.093 0.0750.059 0.024 0.017 0.015	生育 (Absorbance at 650nm) 0.118 0.113 0.122 0.109 0.065 0.019 0.0180.018 0.016 0.020 0.027
Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000	Potassium dichromate 濃度 (μM) 0.000 0.002 0.005 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000
生育 (Absorbance at 650nm) 0.111 0.116 0.127 0.123 0.125 0.120 0.1140.085 0.014 0.009 0.018	生育 (Absorbance at 650nm) 0.115 0.107 0.114 0.113 0.111 0.110 0.1160.115 0.112 0.104 0.079
Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000	Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300
生育 (Absorbance at 650nm) 0.106 0.098 0.115 0.115 0.111 0.102 0.0900.055 0.020 0.017 0.016	生育 (Absorbance at 650nm) 0.107 0.112 0.110 0.106 0.105 0.106 0.1000.108 0.104 0.091 0.083
Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333.000	【0012】
生育 (Absorbance at 650nm) 0.090 0.095 0.121 0.125 0.119 0.112 0.0950.063 0.021 0.020 0.070	【表2】(2) Acetobacter pasteurianus IF03129の化学物質感受性
Di-2-ethylhexyl phthalate 濃度 (μM) 0.000 0.042 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.667 833.000	Methylmercury chloride 濃度 (μM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000 222.000 666.000
生育 (Absorbance at 650nm) 0.091 0.087 0.118 0.114 0.118 0.116 0.1100.094 0.066 0.047 0.0522,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.524 4.572 13.716	生育 (Absorbance at 650nm) 0.260 0.313 0.292 0.269 0.165 0.036 0.0470.047 0.041 0.034 0.032
41.148 123.444 370.333 1111.000 3333.000	Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.098 0.090 0.121 0.122 0.126 0.127 0.1060.070 0.021 0.017 0.017	生育 (Absorbance at 650nm) 0.556 0.345 0.265 0.264 0.261 0.265 0.5840.272 0.480 0.114 0.026
2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.667 2222.000 6666.000	2-Aminoanthracene 濃度 (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.099 0.098 0.118 0.126	生育 (Absorbance at 650nm) 0.272 0.296 0.284 0.269 0.267 0.264 0.2370.198 0.166 0.031 -0.040
	Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000
	生育 (Absorbance at 650nm) 0.278 0.047 0.047 0.047

0.046 0.046 0.0390.025 0.013 0.016 0.030
 Malathion 濃度 (μM) 0.000 0.034 0.102 0.305 0.914
 2.741 8.222 24.66774.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.265 0.252 0.255 0.253
 0.243 0.230 0.2310.223 0.214 0.168 0.083
 Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6
 8.584 205.753 617.2591851.778 5555.333 16666.000
 生育 (Absorbance at 650nm) 0.323 0.300 0.323 0.305
 0.289 0.283 0.2670.224 0.178 0.071 0.032
 Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2
 7.432 82.296 246.889740.667 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.234 0.234 0.235 0.235
 0.221 0.168 0.1370.164 0.158 0.132 -0.114
 Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.271 0.228 0.213 0.199
 0.155 0.073 0.0290.021 0.023 0.021 0.021
 Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.648 0.580 0.288 0.285
 0.274 0.140 0.0700.036 0.023 0.023 0.068
 4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00
 0
 生育 (Absorbance at 650nm) 0.296 0.299 0.298 0.303
 0.303 0.289 0.2810.240 0.154 0.021 0.024
 Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.077 0.079 0.078 0.079
 0.076 0.074 0.0710.054 0.047 0.047 0.048
 Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037111.111 333.333 1000.000
 生育 (Absorbance at 650nm) 0.349 0.311 0.314 0.276
 0.236 0.193 0.1560.123 0.049 0.032 0.024
 Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3
 70 4.111 12.333 37.000111.000 333.000
 生育 (Absorbance at 650nm) 0.341 0.323 0.371 0.332
 0.671 0.601 0.5970.250 0.642 0.059 0.027
 Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.252 0.247 0.245 0.227
 0.210 0.192 0.1600.120 0.021 0.017 0.024
 Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
 572 13.716 41.148123.444 370.333 1111.000 3333.000
 生育 (Absorbance at 650nm) 0.246 0.257 0.242 0.250
 0.242 0.225 0.2010.090 0.030 0.024 0.178
 Di-2-ethylhexyl phthalate 濃度 (μM) 0.000 0.042
 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66
 7 833.000
 生育 (Absorbance at 650nm) 0.245 0.235 0.235 0.234

0.238 0.223 0.2130.188 0.159 0.119 0.055
 2,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.
 524 4.572 13.716
 41.148 123.444 370.333 1111.000 3333.000生育 (Abso
 rbance at 650nm) 0.252 0.264 0.260 0.262 0.235 0.2
 38 0.2300.193 0.036 0.029 0.024
 2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000
 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6
 67 2222.000 6666.000 —
 生育 (Absorbance at 650nm) 0.248 0.262 0.257 0.265
 0.254 0.246 0.2180.191 0.135 0.032 0.045
 Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
 285 6.856 20.568
 61.704 185.111 555.333 1666.000
 生育 (Absorbance at 650nm) 0.252 0.266 0.248 0.247
 0.262 0.233 0.2270.174 0.035 0.034 0.033
 p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305
 0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.280 0.271 0.275 0.269
 0.249 0.185 0.0120.010 0.010 0.014 0.042
 Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.281 0.265 0.234 0.165
 0.279 0.282 0.2650.259 0.166 0.036 0.013
 Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
 1.370 4.111 12.33337.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.286 0.294 0.331 0.383
 0.279 0.361 0.2700.150 0.041 0.035 0.025
 2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
 1.524 4.572 13.71641.148 123.444 370.333 1111.000
 3333.000
 生育 (Absorbance at 650nm) 0.285 0.270 0.265 0.201
 0.110 0.027 0.0260.023 0.022 0.035 0.046Potassium
 dichlomite 濃度 (μM) 0.000 0.002 0.005 0.015 0.0
 45 0.1360.407 1.222 3.667 11.000 33.000生育 (Absor
 bance at 650nm) 0.281 0.267 0.546 0.276 0.275 0.73
 6 0.2710.264 0.259 0.473 0.218
 Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300
 生育 (Absorbance at 650nm) 0.323 0.454 0.311 0.303
 0.476 0.288 0.2870.290 0.275 0.273 0.240
 【0013】
 【表3】(3) Glycomyces rutagersensis IF014488の
 化学物質感受性
 Methylmercury chloride 濃度 (μM) 0.000 0.034 0.10
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66
 6.000
 生育 (Absorbance at 650nm) 0.066 0.065 0.069 0.068
 0.047 0.042 0.0380.032 0.026 0.021 0.018
 Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524

4.572 13.716 41.148123.444 370.333 1111.000 3333.000	Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
生育 (Absorbance at 650nm) 0.041 0.038 0.039 0.042	2 0.457 1.370 4.11112.333 37.000 111.000 333.000
0.042 0.044 0.0420.040 0.025 0.025 0.024	生育 (Absorbance at 650nm) 0.045 0.043 0.042 0.037
2-Aminoanthracene 濃度 (μM) 0.000 0.169 0.508 1.5	0.033 0.033 0.0330.031 0.029 0.029 0.027
24 4.572 13.716 41.148123.444 370.333 1111.000 333	Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
3.000	572 13.716 41.148123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.076 0.070 0.076 0.069	生育 (Absorbance at 650nm) 0.060 0.058 0.062 0.064
0.061 0.058 0.0470.029 0.003 -0.015 -0.157	0.059 0.055 0.0520.042 0.030 0.026 0.058Di-2-ethy
Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010	lhexyl phthalate 濃度 (μM) 0.000 0.042 0.127 0.38
0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000生育	1 1.143 3.42810.284 30.852 92.556 277.667 833.000
生育 (Absorbance at 650nm) 0.058 0.053 0.052 0.051	生育 (Absorbance at 650nm) 0.052 0.052 0.053 0.051
0.050 0.043 0.0370.029 0.025 0.026 0.036	0.053 0.051 0.0500.039 0.036 0.022 0.020
Malathion 濃度 (μM) 0.000 0.034 0.102 0.305 0.914	2,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.
2.741 8.222 24.66774.000 222.000 666.000	524 4.572 13.716
生育 (Absorbance at 650nm) 0.059 0.052 0.053 0.052	41.148 123.444 370.333 1111.000 3333.000
0.054 0.053 0.0540.051 0.048 0.045 0.006	生育 (Absorbance at 650nm) 0.062 0.059 0.061 0.060
Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6	0.059 0.056 0.0540.044 0.030 0.024 0.0202,4-Dichl
8.584 205.753 617.2591851.778 5555.333 16666.000	orophenoxy acetic acid 濃度 (μM) 0.000 0.339 1.01
生育 (Absorbance at 650nm) 0.044 0.059 0.059 0.061	6 3.048 9.14427.432 82.296 246.889 740.667 2222.00
0.059 0.054 0.0500.047 0.038 0.032 0.025	0 6666.000
Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2	生育 (Absorbance at 650nm) 0.062 0.058 0.063 0.061
7.432 82.296 246.889740.667 2222.000 6666.000	0.057 0.055 0.0520.050 0.033 0.022 0.026
生育 (Absorbance at 650nm) 0.049 0.046 0.046 0.050	Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
0.049 0.048 0.0490.066 0.073 0.090 -0.082	285 6.856 20.56861.704 185.111 555.333 1666.000
Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3	生育 (Absorbance at 650nm) 0.054 0.050 0.054 0.054
05 0.914 2.741 8.22224.667 74.000 222.000 666.000	0.053 0.052 0.0510.050 0.048 0.036 0.021
生育 (Absorbance at 650nm) 0.052 0.049 0.049 0.046	p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305
0.044 0.038 0.0290.027 0.028 0.028 0.030	0.914 2.741 8.22224.667 74.000 222.000 666.000
Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15	生育 (Absorbance at 650nm) 0.056 0.054 0.052 0.052
2 0.457 1.370 4.11112.333 37.000 111.000 333.000	0.048 0.045 0.0310.021 0.019 0.023 0.069
生育 (Absorbance at 650nm) 0.053 0.053 0.053 0.050	Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
0.049 0.047 0.0420.027 0.027 0.029 0.133	0.457 1.370 4.111
4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.	12.333 37.000 111.000 333.000
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00	生育 (Absorbance at 650nm) 0.049 0.047 0.049 0.047
0	0.047 0.045 0.0440.040 0.040 0.041 0.035
生育 (Absorbance at 650nm) 0.066 0.061 0.059 0.056	Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
0.055 0.054 0.0480.047 0.043 0.036 0.030	1.370 4.111 12.33337.000 111.000 333.000
Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152	生育 (Absorbance at 650nm) 0.053 0.048 0.049 0.047
0.457 1.370 4.11112.333 37.000 111.000 333.000	0.044 0.042 0.0340.028 0.023 0.022 0.025
生育 (Absorbance at 650nm) 0.055 0.053 0.058 0.058	2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
0.054 0.049 0.0450.042 0.035 0.026 0.019	1.524 4.572 13.71641.148 123.444 370.333 1111.000
Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372	3333.000
4.115 12.346 37.037111.111 333.333 1000.000	生育 (Absorbance at 650nm) 0.056 0.053 0.053 0.050
生育 (Absorbance at 650nm) 0.053 0.051 0.054 0.055	0.039 0.033 0.0310.029 0.031 0.030 0.046
0.054 0.054 0.0510.049 0.052 0.046 0.041	Potassium dichlomite 濃度 (μM) 0.000 0.002 0.005
Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3	0.015 0.045 0.136
70 4.111 12.333 37.000111.000 333.000生育 (Absorba	0.407 1.222 3.667 11.000 33.000
nce at 650nm) 0.057 0.050 0.050 0.051 0.050 0.047	生育 (Absorbance at 650nm) 0.041 0.036 0.041 0.043
0.0440.042 0.032 0.025 0.030	0.043 0.043 0.0440.042 0.040 0.037 0.037
	Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001

0.002 0.005 0.014
 0.041 0.122 0.367 1.100 3.300
 生育 (Absorbance at 650nm) 0.044 0.045 0.049 0.049
 0.049 0.052 0.0500.044 0.034 0.026 0.020
 【0014】
 【表4】(4) Aureobacterium esteraromatium IF0 37
 52の化学物質感受性
 Methylmercury chloride 濃度 (μM) 0.000 0.034 0.10
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66
 6.000
 生育 (Absorbance at 650nm) 0.091 0.107 0.110 0.093
 0.043 0.023 0.0220.023 0.022 0.021 0.018
 Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148123.444 370.333 1111.000 3333.
 000
 生育 (Absorbance at 650nm) 0.098 0.106 0.116 0.112
 0.116 0.111 0.1120.114 0.110 0.084 0.016
 2-Aminoanthracene 濃度 (μM) 0.000 0.169 0.508 1.5
 24 4.572 13.716 41.148123.444 370.333 1111.000 333
 3.000
 生育 (Absorbance at 650nm) 0.095 0.093 0.113 0.104
 0.099 0.099 0.0900.091 0.069 0.008 -0.108
 Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010
 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000
 生育 (Absorbance at 650nm) 0.105 0.037 0.044 0.044
 0.042 0.038 0.0300.018 0.014 0.023 0.032Malathion
 濃度 (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.
 222 24.66774.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.101 0.098 0.122 0.120
 0.119 0.113 0.1050.100 0.088 0.068 -0.001
 Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6
 8.584 205.753 617.2591851.778 5555.333 16666.000
 生育 (Absorbance at 650nm) 0.100 0.099 0.121 0.114
 0.107 0.105 0.1010.098 0.085 0.045 0.023
 Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2
 7.432 82.296 246.889740.667 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.103 0.110 0.131 0.132
 0.126 0.099 0.0770.093 0.103 0.111 -0.059
 Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.095 0.098 0.116 0.115
 0.093 0.054 0.0220.021 0.019 0.017 0.021
 Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000生育
 生育 (Absorbance at 650nm) 0.089 0.098 0.107 0.107
 0.103 0.089 0.0560.039 0.030 0.023 0.056
 4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00
 0
 生育 (Absorbance at 650nm) 0.106 0.111 0.121 0.118

0.118 0.118 0.1010.096 0.081 0.068 0.066
 Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.111
 12.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.096 0.097 0.118 0.117
 0.113 0.110 0.1070.099 0.087 0.077 0.126
 Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037111.111 333.333 1000.000
 生育 (Absorbance at 650nm) 0.097 0.089 0.120 0.117
 0.112 0.104 0.0890.085 0.065 0.049 0.032
 Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3
 70 4.111 12.333 37.000111.000 333.000
 生育 (Absorbance at 650nm) 0.107 0.102 0.121 0.120
 0.122 0.119 0.1160.105 0.074 0.024 0.036
 Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.090 0.094 0.119 0.119
 0.112 0.105 0.0930.085 0.046 0.020 0.020
 Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
 572 13.716 41.148123.444 370.333 1111.000 3333.000
 生育 (Absorbance at 650nm) 0.088 0.092 0.123 0.123
 0.121 0.111 0.0950.080 0.019 0.018 0.052
 Di-2-ethylhexyl phthalate 濃度 (μM) 0.000 0.042
 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66
 7 833.000生育 (Absorbance at 650nm) 0.087 0.069 0.
 122 0.119 0.121 0.117 0.1090.096 0.075 0.052 0.048
 2,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.
 524 4.572 13.71641.148 123.444 370.333 1111.000 33
 33.000
 生育 (Absorbance at 650nm) 0.097 0.103 0.129 0.127
 0.128 0.122 0.1130.086 0.020 0.017 0.019
 2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000
 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6
 67 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.093 0.103 0.124 0.122
 0.124 0.124 0.1160.100 0.075 0.018 0.027
 Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
 285 6.856 20.56861.704 185.111 555.333 1666.000
 生育 (Absorbance at 650nm) 0.097 0.107 0.122 0.123
 0.119 0.121 0.1200.112 0.084 0.044 0.015
 p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305
 0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.102 0.090 0.076 0.111
 0.108 0.095 0.0150.016 0.013 0.022 0.101
 Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.098 0.094 0.122 0.120
 0.119 0.119 0.1110.107 0.100 0.088 0.065
 Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
 1.370 4.111 12.33337.000 111.000 333.000

生育 (Absorbance at 650nm) 0.105 0.097 0.124 0.122
 0.123 0.109 0.0820.040 0.020 0.017 0.016
 2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
 1.524 4.572 13.71641.148 123.444 370.333 1111.000
 3333.000
 生育 (Absorbance at 650nm) 0.098 0.095 0.115 0.110
 0.081 0.021 0.0200.020 0.020 0.023 0.033
 Potassium dichlomite 濃度 (μM) 0.000 0.002 0.005
 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000
 生育 (Absorbance at 650nm) 0.105 0.101 0.121 0.122
 0.124 0.117 0.1180.120 0.116 0.109 0.088
 Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300
 生育 (Absorbance at 650nm) 0.100 0.096 0.107 0.110
 0.109 0.103 0.1000.085 0.056 0.029 0.019
 【0015】
 【表5】(5) Comamonas Testosteroni IAM1048の化学
 物質感受性
 Methylmercury chloride 濃度 (μM) 0.000 0.034 0.10
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66
 6.000
 生育 (Absorbance at 650nm) 0.420 0.419 0.417 0.381
 0.080 0.059 0.0560.056 0.057 0.048 0.039
 Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148123.444 370.333 1111.000 3333.
 000
 生育 (Absorbance at 650nm) 0.316 0.302 0.314 0.313
 0.303 0.302 0.2930.285 0.279 0.178 -0.005
 2-Aminoanthracene 濃度 (μM) 0.000 0.169 0.508 1.5
 24 4.572 13.716 41.148123.444 370.333 1111.000 333
 3.000生育 (Absorbance at 650nm) 0.417 0.412 0.435
 0.420 0.425 0.413 0.3900.335 0.248 0.118 -0.084
 Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010
 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000
 生育 (Absorbance at 650nm) 0.401 0.406 0.401 0.394
 0.373 0.268 0.1550.074 0.056 0.051 0.072
 Malathion 濃度 (μM) 0.000 0.034 0.102 0.305 0.914
 2.741 8.222 24.66774.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.341 0.341 0.346 0.319
 0.314 0.300 0.2880.270 0.234 0.141 -0.101
 Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6
 8.584 205.753 617.2591851.778 5555.333 16666.000
 生育 (Absorbance at 650nm) 0.321 0.302 0.312 0.315
 0.319 0.321 0.3050.302 0.269 0.156 0.000
 Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2
 7.432 82.296 246.889740.667 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.323 0.312 0.316 0.313
 0.302 0.267 0.2400.258 0.405 0.750 1.157
 Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.393 0.404 0.401 0.400
 0.379 0.337 0.2820.158 0.039 0.035 0.037
 Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.391 0.562 0.456 0.411
 0.418 0.361 0.2670.089 0.046 0.035 0.089
 4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00
 0生育 (Absorbance at 650nm) 0.399 0.406 0.412 0.39
 8 0.402 0.386 0.3660.355 0.345 0.284 0.140
 Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.416 0.425 0.445 0.443
 0.432 0.430 0.4250.409 0.386 0.306 -0.108
 Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037111.111 333.333 1000.000
 生育 (Absorbance at 650nm) 0.327 0.314 0.326 0.313
 0.304 0.294 0.2590.168 -0.085 -0.543 -1.517
 Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3
 70 4.111 12.333 37.000111.000 333.000
 生育 (Absorbance at 650nm) 0.316 0.304 0.314 0.311
 0.304 0.303 0.2840.257 0.165 0.041 0.003
 Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.307 0.294 0.302 0.294
 0.287 0.297 0.2860.262 0.201 0.068 -0.269
 Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
 572 13.716 41.148123.444 370.333 1111.000 3333.000
 生育 (Absorbance at 650nm) 0.413 0.420 0.425 0.428
 0.423 0.388 0.3530.223 0.054 0.049 0.157
 Di-2-ethylhexyl phthalate 濃度 (μM) 0.000 0.042
 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66
 7 833.000
 生育 (Absorbance at 650nm) 0.432 0.414 0.440 0.437
 0.438 0.426 0.4360.417 0.110 0.021 -0.143
 2,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.
 524 4.572 13.71641.148 123.444 370.333 1111.000 33
 33.000
 生育 (Absorbance at 650nm) 0.436 0.442 0.447 0.449
 0.454 0.430 0.1340.083 0.054 0.049 0.040
 2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000
 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6
 67 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.427 0.430 0.438 0.443
 0.446 0.434 0.4210.390 0.099 0.044 0.052
 Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
 285 6.856 20.56861.704 185.111 555.333 1666.000
 生育 (Absorbance at 650nm) 0.437 0.428 0.444 0.446
 0.442 0.427 0.4330.429 0.430 0.382 0.077
 p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305

0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.403 0.387 0.412 0.408
 0.388 0.364 0.2930.216 0.182 0.142 0.022
 Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.407 0.407 0.403 0.436
 0.416 0.399 0.3830.365 0.333 0.242 0.129
 Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
 1.370 4.111 12.33337.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.404 0.401 0.426 0.416
 0.391 0.362 0.2530.191 0.083 0.037 0.047
 2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
 1.524 4.572 13.71641.148 123.444 370.333 1111.000
 3333.000
 生育 (Absorbance at 650nm) 0.411 0.398 0.397 0.390
 0.313 0.063 0.0500.052 0.049 0.041 0.077
 Potassium dichromate 濃度 (μM) 0.000 0.002 0.005
 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000
 生育 (Absorbance at 650nm) 0.323 0.303 0.322 0.318
 0.311 0.303 0.2960.296 0.289 0.273 0.226
 Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300
 生育 (Absorbance at 650nm) 0.321 0.315 0.328 0.327
 0.317 0.304 0.2820.280 0.237 0.197 0.118
 【0016】
 【表6】(6) *Pseudomonas synxantha* IFO 3913の化学
 物質感受性
 Methylmercury chloride 濃度 (μM) 0.000 0.034 0.10
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66
 6.000
 生育 (Absorbance at 650nm) 0.719 0.716 0.728 0.733
 0.736 0.476 0.0700.060 0.056 0.057 0.046
 Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524
 4.572 13.716 41.148123.444 370.333 1111.000 3333.
 000
 生育 (Absorbance at 650nm) 0.667 0.686 0.673 0.673
 0.673 0.666 0.6620.666 0.659 0.542 0.051
 2-Aminoanthracene 濃度 (μM) 0.000 0.169 0.508 1.5
 24 4.572 13.716 41.148123.444 370.333 1111.000 333
 3.000
 生育 (Absorbance at 650nm) 0.784 0.785 0.804 0.794
 0.805 0.803 0.7690.723 0.682 0.548 0.150
 Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010
 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000
 生育 (Absorbance at 650nm) 0.748 0.773 0.767 0.776
 0.769 0.761 0.7610.729 0.351 0.077 0.057
 Malathion 濃度 (μM) 0.000 0.034 0.102 0.305 0.914
 2.741 8.222 24.66774.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.717 0.714 0.708 0.696
 0.695 0.680 0.6880.706 0.778 0.751 0.180

Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6
 8.584 205.753 617.2591851.778 5555.333 16666.000
 生育 (Absorbance at 650nm) 0.624 0.649 0.646 0.615
 0.594 0.541 0.4220.298 0.203 0.116 0.053
 Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2
 7.432 82.296 246.889740.667 2222.000 6666.000
 生育 (Absorbance at 650nm) 0.655 0.657 0.647 0.660
 0.644 0.606 0.5930.597 0.571 0.451 -0.032
 Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000
 生育 (Absorbance at 650nm) 0.770 0.775 0.774 0.763
 0.756 0.726 0.7110.692 0.708 0.731 0.158
 Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.701 0.712 0.726 0.723
 0.723 0.714 0.7110.730 0.700 0.382 0.149
 4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00
 0
 生育 (Absorbance at 650nm) 0.746 0.754 0.768 0.748
 0.753 0.741 0.7180.725 0.747 0.845 0.630
 Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152
 0.457 1.370 4.11112.333 37.000 111.000 333.000生育
 (Absorbance at 650nm) 0.782 0.802 0.814 0.819 0.8
 03 0.806 0.7930.775 0.773 0.774 0.558
 Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372
 4.115 12.346 37.037111.111 333.333 1000.000
 生育 (Absorbance at 650nm) 0.680 0.691 0.679 0.669
 0.659 0.638 0.5550.440 0.308 0.221 0.154
 Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3
 70 4.111 12.333 37.000111.000 333.000
 生育 (Absorbance at 650nm) 0.695 0.720 0.712 0.697
 0.676 0.668 0.6690.692 0.760 0.808 0.261
 Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000
 生育 (Absorbance at 650nm) 0.677 0.704 0.696 0.698
 0.683 0.676 0.6480.592 0.529 0.471 0.381
 Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
 572 13.716 41.148123.444 370.333 1111.000 3333.000
 生育 (Absorbance at 650nm) 0.787 0.805 0.812 0.817
 0.821 0.807 0.8210.836 0.573 0.686 0.455Di-2-ethy
 lhexyl phthalate 濃度 (μM) 0.000 0.042 0.127 0.38
 1 1.143 3.42810.284 30.852 92.556 277.667 833.000
 生育 (Absorbance at 650nm) 0.784 0.757 0.792 0.794
 0.783 0.772 0.7730.772 0.788 0.783 0.582
 2,5-Dichlorophenol 濃度 (μM) 0.000 0.169 0.508 1.
 524 4.572 13.71641.148 123.444 370.333 1111.000 33
 33.000
 生育 (Absorbance at 650nm) 0.788 0.805 0.810 0.818
 0.822 0.824 0.8300.852 0.767 0.075 0.024

2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000
0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.6
67 2222.000 6666.000

生育 (Absorbance at 650nm) 0.761 0.773 0.785 0.797
0.801 0.795 0.801 0.835 0.906 0.945 0.045

Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
285 6.856 20.568 61.704 185.111 555.333 1666.000

生育 (Absorbance at 650nm) 0.765 0.752 0.776 0.784
0.785 0.779 0.789 0.789 0.784 0.765 0.740

p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305
0.914 2.741 8.222 24.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.758 0.762 0.775 0.763
0.737 0.708 0.726 0.621 0.484 0.420 0.289

Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
0.457 1.370 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.776 0.773 0.786 0.778
0.762 0.735 0.715 0.680 0.663 0.615 0.520

Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
1.370 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.769 0.773 0.774 0.771
0.773 0.756 0.737 0.703 0.652 0.624 0.354

2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
1.524 4.572 13.716 41.148 123.444 370.333 1111.000
3333.000

生育 (Absorbance at 650nm) 0.750 0.759 0.763 0.759
0.736 0.701 0.657 0.562 0.044 0.033 0.081

Potassium dichromate 濃度 (μM) 0.000 0.002 0.005
0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000

生育 (Absorbance at 650nm) 0.644 0.664 0.668 0.659
0.651 0.631 0.636 0.634 0.630 0.602 0.501

Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001
0.002 0.005 0.014 0.041 0.122 0.367 1.100 3.300

生育 (Absorbance at 650nm) 0.624 0.631 0.621 0.636
0.635 0.622 0.621 0.641 0.672 0.738 0.418

【0017】

【表7】(7) Staphylococcus aureus IF0 3060の化学
物質感受性

Methylmercury chloride 濃度 (μM) 0.000 0.034 0.10
2 0.305 0.914 2.741 8.222 24.667 74.000 222.000 66
6.000

生育 (Absorbance at 650nm) 0.184 0.198 0.200 0.189
0.007 0.006 0.006 0.007 0.008 0.007 0.005

Nickel chloride 濃度 (μM) 0.000 0.169 0.508 1.524
4.572 13.716 41.148 123.444 370.333 1111.000 3333.
000

生育 (Absorbance at 650nm) 0.237 0.232 0.226 0.227
0.224 0.220 0.216 0.216 0.208 0.111 0.007 2-Aminoan

thracene 濃度 (μM) 0.000 0.169 0.508 1.524 4.572
13.716 41.148 123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.174 0.181 0.176 0.173

0.170 0.168 0.167 0.155 0.124 0.121 0.033

Tributyltin chloride 濃度 (μM) 0.000 0.003 0.010
0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000

生育 (Absorbance at 650nm) 0.154 0.177 0.185 0.183
0.160 0.109 0.085 0.045 0.020 0.010 0.029

Malathion 濃度 (μM) 0.000 0.034 0.102 0.305 0.914
2.741 8.222 24.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.235 0.226 0.223 0.219
0.216 0.211 0.215 0.222 0.231 0.226 0.063

Phenol 濃度 (μM) 0.000 0.847 2.540 7.620 22.861 6
8.584 205.753 617.259 1851.778 5555.333 16666.000

生育 (Absorbance at 650nm) 0.256 0.192 0.199 0.198
0.197 0.193 0.193 0.190 0.180 0.159 0.043

Lindane 濃度 (μM) 0.000 0.339 1.016 3.048 9.144 2
7.432 82.296 246.889 740.667 2222.000 6666.000

生育 (Absorbance at 650nm) 0.177 0.095 0.085 0.080
0.075 0.071 0.080 0.074 0.106 0.055 -0.230

Pentachlorophenol 濃度 (μM) 0.000 0.034 0.102 0.3
05 0.914 2.741 8.222 24.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.146 0.148 0.142 0.129
0.107 0.090 0.073 0.041 0.007 0.002 0.004

Trp-P-2(Acetate) 濃度 (μM) 0.000 0.017 0.051 0.15
2 0.457 1.370 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.189 0.200 0.199 0.187
0.176 0.143 0.084 0.041 0.017 0.012 0.085

4-Nitroquinoline-N-oxide 濃度 (μM) 0.000 0.001 0.
003 0.008 0.023 0.070 0.210 0.630 1.889 5.667 17.00
0

生育 (Absorbance at 650nm) 0.182 0.185 0.185 0.183
0.181 0.177 0.185 0.188 0.191 0.170 0.104

Benzo(a)pyrene 濃度 (μM) 0.000 0.017 0.051 0.152
0.457 1.370 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.162 0.164 0.156 0.158
0.138 0.114 0.094 0.076 0.068 0.062 0.094

Paraquat 濃度 (μM) 0.000 0.051 0.152 0.457 1.372
4.115 12.346 37.037 111.111 333.333 1000.000 生育 (A

bsorbance at 650nm) 0.249 0.241 0.218 0.217 0.217
0.211 0.196 0.177 0.174 0.175 0.161

Maneb 濃度 (μM) 0.000 0.017 0.051 0.152 0.457 1.3
70 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.232 0.230 0.225 0.226
0.223 0.215 0.216 0.212 0.187 0.134 0.013

Cadmium chloride 濃度 (μM) 0.000 0.017 0.051 0.15
2 0.457 1.370 4.111 12.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.237 0.233 0.221 0.215
0.203 0.164 0.159 0.123 0.090 0.076 0.029

Bis-phenol-A 濃度 (μM) 0.000 0.169 0.508 1.524 4.
572 13.716 41.148 123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.159 0.158 0.156 0.156
0.158 0.163 0.162 0.109 0.003 0.003 0.085

Di-2-ethylhexyl phthalate 濃度 (μM) 0.000 0.042
0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.66
7 833.000
生育 (Absorbance at 650nm) 0.158 0.157 0.159 0.152
0.153 0.150 0.151 0.153 0.143 0.080 0.069 2,5-Dichl
orophenol 濃度 (μM) 0.000 0.169 0.508 1.524 4.572
13.716 41.148 123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.156 0.162 0.158 0.157
0.156 0.152 0.086 0.053 0.029 0.001 0.002
2,4-Dichlorophenoxy acetic acid 濃度 (μM) 0.000
0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.6
67 2222.000 6666.000
生育 (Absorbance at 650nm) 0.158 0.159 0.155 0.159
0.159 0.153 0.146 0.116 0.066 0.005 0.011
Formaldehyde 濃度 (μM) 0.000 0.085 0.254 0.762 2.
285 6.856 20.568 61.704 185.111 555.333 1666.000
生育 (Absorbance at 650nm) 0.160 0.159 0.163 0.164
0.162 0.161 0.159 0.161 0.160 0.156 0.147
p-Nonylphenol 濃度 (μM) 0.000 0.034 0.102 0.305
0.914 2.741 8.222 24.667 74.000 222.000 666.000
生育 (Absorbance at 650nm) 0.158 0.165 0.164 0.167
0.143 0.156 0.070 0.068 0.052 0.055 0.160
Sodium Arsenite 濃度 (μM) 0.000 0.017 0.051 0.152
0.457 1.370 4.111 12.333 37.000 111.000 333.000
生育 (Absorbance at 650nm) 0.148 0.148 0.148 0.147
0.149 0.143 0.141 0.131 0.094 0.094 0.070
Thiuram 濃度 (μM) 0.000 0.017 0.051 0.152 0.457
1.370 4.111 12.333 37.000 111.000 333.000
生育 (Absorbance at 650nm) 0.145 0.150 0.150 0.153
0.151 0.146 0.134 0.092 0.029 0.006 0.004
2,4,5-Trichlorophenol 濃度 (μM) 0.000 0.169 0.508
1.524 4.572 13.716 41.148 123.444 370.333 1111.000
3333.000
生育 (Absorbance at 650nm) 0.152 0.155 0.161 0.154
0.109 0.034 0.006 0.005 0.005 0.006 0.000
Potassium dichromate 濃度 (μM) 0.000 0.002 0.005
0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000
生育 (Absorbance at 650nm) 0.241 0.227 0.225 0.224
0.220 0.216 0.219 0.222 0.218 0.207 0.188
Triphenyltin chloride 濃度 (μM) 0.000 0.000 0.001
0.002 0.005 0.014 0.041 0.122 0.367 1.100 3.300
生育 (Absorbance at 650nm) 0.256 0.274 0.260 0.257
0.255 0.254 0.248 0.232 0.129 0.097 0.024

【0018】指標微生物としては、生育阻害を受けやすい種類の異なったものを多数選ぶのが好ましい。このような微生物としては、各化学物質に対する必須指標微生物を選定するのがよい。この必須指標微生物を選定するには、まず、各化学物質について、その大腸菌の生育を阻害する最低濃度を測定し、この最低阻害濃度より低い濃度で生育阻害を受ける微生物を複数選択する（1次ス

クリーニング）。次に、この1次スクリーニングで選択した微生物を、異なる濃度の指標化学物質の存在下で生育させ、その化学物質による生育阻害の特性を観察する。この結果から、1次スクリーニングで選択した微生物の中で最もその化学物質に感受性を示す微生物を、必須指標微生物として選ぶ。もちろん、指標微生物としては、この必須指標微生物の他に、大腸菌よりも生育阻害を受けやすい各種の微生物を指標微生物とすることができ

【0019】前記表1～7に示した結果から理解されるように、Methylmercury chloride, Nickel chloride, 2-Aminoanthracene, Malathion, Phenol, Lindane等の指標化学物質は、Methylmercury chlorideを除いて、明らかに指標微生物に対する阻害が顕著である。ただし、Methylmercury chlorideとTributyltin chlorideについては指標微生物以外にも複数の微生物で顕著な生育阻害が認められた。Methylmercury chlorideについては、全ての指標微生物に対してほぼ同程度の阻害特性を示すが、このような化学物質は他の24種類では認められないことから、Methylmercury chlorideの特徴を示しているものと理解できる。Tributyltin chlorideについては、3種類の微生物に限って阻害を示すことから、これもその生育スペクトルがTributyltin chlorideの特徴を表しているものと理解することができる。以上のことから、上記の化学物質に対する指標微生物の生育特性又は生産スペクトル（微生物／化学物質濃度データ）は、化学物質の特徴を反映していることは明らかである。

【0020】Pentachlorophenol, Trp-P-2(Acetate), 4-Nitroquinoline-N-oxide, Benzo(a)pyrene, Paraquat, Maneb, Cadmium chlorideについては、これらの化合物に感受性を示す微生物が存在するために、生育スペクトルが、特徴的なものとなっている。例えば、Pentachlorophenolに対して、Acetobacter pasteurianus IF03129は感受性を示した。本微生物は本来、Nickel chlorideに対して感受性を示す微生物として選定したが、Pentachlorophenolにも感受性があると理解できる。しかしながら、他の微生物のPentachlorophenolとNickel chlorideに対する感受性が異なることから、その生育スペクトルは明らかに両化学物質が異なるものであることを示している。同様に、Trp-P-2(Acetate), 4-Nitroquinoline-N-oxide, Benzo(a)pyrene, Paraquat, Maneb, Cadmium chlorideについても、感受性を示す指標微生物が存在するが、当該微生物以外のスペクトルが異なることから、区別することができる。

【0021】Bis-phenol-A, Di-2-ethyl hexylphthalate, 2,5-Dichlorophenol, 2,4-Dichlorophenoxy acid, Formaldehyde, p-Nonylphenol, Sodium Arsenite, Thiuram, 2,4,5-Trichlorophenol, Potassium dichromate, Triphenyltin chlorideについては、顕著に感受性を示す微生物は存在しなかった。これらの化合物の内、2,5-Dichloroph

enol, 2,4-Dichlorophenoxy acetic acid, 2,4,5-Trichlorophenolを除くと、これらの化合物に対する微生物の感受性が異なることから、化学物質の生育スペクトルは特徴的な結果となっている。2,5-Dichlorophenol, 2,4-Dichlorophenoxy acetic acid, 2,4,5-Trichlorophenolについては生育スペクトルが類似していた。しかしながらこれらの化合物は類似化合物であることから、その毒性も類似していることが推測され、生育スペクトルが類似するのは当然であると考えることができる。逆に、本発明が化学物質の毒性を表現するために有効であることを示している例であると考えることができる。

【0022】本発明の方法は、試料化学物質の存在下で複数の指標微生物を生育する工程を含む。この場合の生育条件は、前記した指標微生物の存在下で指標化学物質を生育させたときと同じ条件である。また、本発明の方法は、前記生育工程における微生物濃度と試料化合物濃度との関係を測定する測定工程を含む。本発明の方法は、前記測定工程で得られた微生物／化学物質濃度データを、前記データバンクに収納されている指標微生物／

指標化学物質濃度データと照合する照合工程を含む。この照合工程において、試料化学物質と同一又は近似する指標微生物／指標化学物質濃度データが検出されたときには、その試料化合物は、微生物学的に、その検出されたデータにおける指標化学物質と同一又は近似するものと同定される。本発明に使用し得る試料化学物質は、高純度化学物質である必要はなく、化学物質を含む環境水や、化学物質で汚染された汚染水等であることができる。前記した各工程は、いずれも自動的に行うことができる。測定工程で得られたデータのデータバンクに収納されたデータとの照合は、コンピュータを用いて自動的に行うことができる。

【0023】

【発明の効果】本発明によれば、試料化学物質を微生物学的に同定することができる。即ち、その化学物質の種類や構造及びその化学物質の微生物に対する毒性を微生物学的手法により知ることができる。このような方法は、従来全く知られておらず、本発明により初めて得られたもので、その産業的意義は多大である。

フロントページの続き

(72)発明者 藤田 克英

東京都羽村市富士見平2-9-16-107

(72)発明者 亀尾 聡美

宮城県仙台市青葉区上杉一丁目13-24 ロイヤル・セフィラ201

(72)発明者 高橋 幸子

茨城県つくば市東1丁目1番3 工業技術院生命工学工業技術研究所内

(72)発明者 松山 彰収

茨城県つくば市千現1-14-14-304

Fターム(参考) 4B063 QA01 QA18 QQ61 QR74 QS24
QX01

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